:ALIFORNIA ENERGY COMMISSION
16 NINTH STREET
\CRAMENTO, CA 95814-5512

December 21, 2001

REQUEST FOR COMMENTS ON THE ENERGY COMMISSION STAFF'S DRAFT POWER PLANT COOLING OPTIONS ANALYSIS (APPENDIX TO THE BIOLOGICAL RESOURCES FINAL STAFF ASSESSMENT) FOR THE POTRERO POWER PLANT UNIT 7 PROJECT

Enclosed is a copy of the Energy Commission staff's draft cooling options analysis for the Potrero Power Plant Unit 7 Project (Unit 7). The final version will be an appendix to the staff's biological resources section of the Final Staff Assessment (FSA) which is expected to be issued in late-January 2002.

We request that you review the enclosed draft analysis and provide any written comments to Marc Pryor, the Energy Commission's Project Manager by **January 9, 2002**.

<u>Purpose of Analysis</u>

The proposed once-through cooling system for the Unit 7 project would use large quantities of water, pulling cooled water from the San Francisco Bay and returning almost all of the water, warmed, to the Bay. This analysis of power plant cooling options at Potrero was undertaken for two reasons. First, staff has identified potential adverse impacts to aquatic biological resources that would result from the proposed use of once-through cooling. Second, the McAteer-Petris Act, which governs actions of the Bay Conservation and Development Commission (BCDC), requires that an analysis of feasible alternatives be considered prior to taking action on the proposed project. Options being considered by BCDC include dry cooling and hybrid cooling. Therefore, this report will support both the Energy Commission's impact analysis under CEQA and the BCDC's consideration of the project's compliance with the McAteer-Petris Act.

This draft analyzes the potential impacts of two cooling technologies: a dry cooling system and a hybrid (wet/dry) cooling system. The dry cooling system utilizes air-cooled condensers (ACCs) to cool turbine exhaust, and the hybrid system (also called a parallel condensing wet/dry system) would use reclaimed water for cooling and as well as ACCs. A 100% wet cooling system is described but not considered because the use of wet cooling without plume abatement (which is included in the hybrid design) would create frequent visible vapor plumes given the climate conditions in San Francisco.

Summary of Conclusions

The disciplines in which potential impacts from dry and hybrid cooling technologies are of most concern are air quality, noise, visual resources, land use, and power plant efficiency. For both air quality and noise, impacts of dry and hybrid cooling would be greater than those of once-through cooling but mitigation is feasible and available to reduce impacts to less than significant levels. Visual impacts of the hybrid cooling system would not be significant but impacts of the dry cooling equipment would be significant and unmitigable from several viewpoints. As a result of the visual impacts, dry cooling would also create land use incompatibility.

Dry and hybrid cooling technologies are less efficient than once-through cooling in cooling steam so power generation is slightly reduced using these technologies. Also, additional electricity is required to operate the cooling fans so net power generation is reduced for that reason as well. These reductions in efficiency are found to be small (2.5% for dry cooling and 1% for hybrid cooling) and they are determined not to cause significant adverse impacts on the availability of fuel or to cause wasteful or inefficient energy consumption.

Further Information

If you want information on how you can participate in the Energy Commission's review of the project, please contact Ms. Roberta Mendonca, the Energy Commission's Public Adviser, at (916) 654-4489 (toll free in California at (800) 822-6228), or by email at pao@energy.state.ca.us. Technical or project schedule questions should be directed to Marc Pryor, Siting Project Manager, in the Energy Facilities Siting and Environmental Protection Division, at (916) 653-0159, or by email at mpryor@energy.state.ca.us. A copy of the report, the status of the project, copies of notices and other relevant documents are also available on the Energy Commission's Internet web page at **www.energy.ca.gov/sitingcases/potrero**. News media inquiries should be directed to Assistant Executive Director, Claudia Chandler, at (916) 654-4989.

Sincerely,

PAUL RICHINS, JR.
Energy Facilities Licensing Manager

Enclosure

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CALIFORNIA ENERGY COMMISSION STAFF'S APPENDIX TO BIOLOGICAL RESOURCES POTRERO POWER PLANT COOLING OPTIONS

POTRERO POWER PLANT UNIT 7 PROJECT
(00-AFC-4)

DECEMBER 21, 2001

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**CALIFORNIA ENERGY COMMISSION STAFF'S
APPENDIX TO BIOLOGICAL RESOURCES
POTRERO POWER PLANT COOLING OPTIONS**

**POTRERO POWER PLANT UNIT 7 PROJECT
(00-AFC-4)**

DECEMBER 21, 2001

DRAFT

POTRERO POWER PLANT COOLING OPTIONS

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APPENDIX TO BIOLOGICAL RESOURCES
POTRERO POWER PLANT COOLING OPTIONS

Susan V. Lee and James C. Henneforth

1 INTRODUCTION

PURPOSE OF REPORT

The proposed once-through cooling system for the Potrero Unit 7 Project (Unit 7) would use large quantities of water, pulling cooled water from the San Francisco Bay and returning almost all of the water, warmed, to the Bay. This analysis of cooling options at Potrero was undertaken for two reasons. First, this Final Staff Assessment (FSA) for the Unit 7project identifies potential impacts to aquatic biological resources that would result from the proposed use of once-through cooling. Second, the McAteer-Petris Act, which governs actions of the Bay Conservation and Development Commission (BCDC), requires that an analysis of feasible alternatives be considered prior to taking action on the proposed project which requires construction of a new intake and outfall structure in the Bay, resulting in filling of additional baylands. Options being considered by BCDC include dry cooling and hybrid cooling. Therefore, this report will support both the Energy Commission's impact analysis under CEQA and the BCDC's consideration of the project's compliance with the McAteer-Petris Act.

This report analyzes the potential impacts of two cooling technologies: a dry cooling system and a hybrid (wet/dry) cooling system. The dry cooling system utilizes air-cooled condensers (ACCs) to cool turbine exhaust, and the hybrid system (also called a parallel condensing wet/dry system) uses water for cooling and as well as ACCs. A 100% wet cooling system is not considered because, although sufficient water is available from the City's Southeast Water Treatment Plant, use of wet cooling without plume abatement (which is included in the hybrid design) would create frequent visible vapor plumes given the climate conditions in San Francisco.

SUMMARY OF CONCLUSIONS

The disciplines in which potential impacts from dry and hybrid cooling technologies are of most concern are air quality, noise, visual resources, land use, and power plant efficiency. For both air quality and noise, impacts of dry and hybrid cooling would be greater than those of once-through cooling, but mitigation is feasible and available to reduce impacts to less than significant levels. Visual impacts of the hybrid cooling system would not be significant, but impacts of the dry cooling equipment would be significant and unmitigable from several viewpoints. As a result of the visual impacts, dry cooling would also create land use incompatibility.

Dry and hybrid cooling technologies are less efficient than once-through cooling in cooling steam, so power generation is slightly reduced using these technologies. Also, additional electricity is required to operate the cooling fans, so net power generation is reduced for that reason as well. These reductions in efficiency are found to be small (2.5% for dry cooling and 1% for hybrid cooling), and they are determined not to cause significant adverse impacts on the availability of fuel or to cause wasteful or inefficient energy consumption.

REPORT CONTENTS

This report includes six chapters that include the information shown below.

1. Introduction
Chapter 1 describes the purpose of the report, the cooling options that are reviewed in this report, report contents, the roles of the Energy Commission and the BCDC, and a brief description of the aquatic biology impacts of concern.

2. Background on Cooling Options
Chapter 2 provides an overview review of the cooling technologies considered in this report: (dry cooling and hybrid cooling). It describes the basic technologies and how they work, where the technologies are currently used, and the advantages and disadvantages of each.

3. Conceptual Design of Cooling Options for Potrero Power Plant
Chapter 3 presents specific designs for cooling options to replace or enhance the once-through cooling system proposed by Mirant. This Chapter presents two possible locations for a dry cooling system and one for a hybrid cooling system.

4. Environmental Analysis of Cooling Options
Chapter 4 analyzes the environmental effects of the cooling options and the alternative locations for each of the issue areas that would be substantially affected (e.g., air quality, aquatic biology, visual, etc.).

5. Engineering Analysis of Cooling Options
Chapter 5 includes the engineering analyses for power plant reliability and efficiency, facility design, and geology and paleontology.

6. Conclusion: Comparison of Cooling Options
Chapter 6 presents overall conclusions about the environmental and engineering effects of the cooling options.

7. References
This chapter provides a list of references for the entire Biological Resources Appendix.

ROLES OF THE ENERGY COMMISSION AND THE BAY CONSERVATION AND DEVELOPMENT COMMISSION

The Energy Commission is the Lead Agency for the review of the proposed Potrero Unit 7 Project under CEQA. As part of this analysis, the Energy Commission evaluates the potential environmental impacts of the proposed project and considers feasible mitigation for significant impacts. In this case, potential impacts of once-through cooling could occur in the areas of aquatic biology and soils/hazardous materials.

The Potrero Unit 7 Project must also be evaluated for its compliance with Laws, Ordinances, Regulations, and Standards (LORS). The McAteer-Petris Act (MPA) governs the actions of the San Francisco Bay Conservation and Development Commission (BCDC). Government Code Section 66605(b) of the MPA is a BCDC policy statement that fill in the bay should be authorized "only when no alternative upland location is available for such purpose." For a power plant proposed within the area of BCDC's jurisdiction, the MPA requires BCDC to provide the Energy Commission a report on the consistency of a proposed project with the provisions of the MPA and the San Francisco Bay Plan and the degree to which the proposed site and related facilities could reasonably be modified to be made consistent with those provisions (Government Code Section 66645(d)).

The Energy Commission is required to include in its written decision specific provisions to meet the requirements of the MPA as may be specified in the report submitted by BCDC pursuant to Section 66645(d) of the Government Code unless the Energy Commission specifically finds that the adoption of the provisions specified by BCDC would result in greater adverse effect on the environment or the provisions proposed in the report would not be feasible (Public Resources Code Section 25523(c)).

Therefore, this analysis evaluates the potential impacts of two cooling technologies that would not require bay fill.

AQUATIC BIOLOGY IMPACTS OF CONCERN

The proposed Unit 7 project includes three actions that are of concern in the aquatic biology analysis: (1) intake of an additional 227 million gallons per day (mgd) of seawater for once-through cooling of Unit 7, (2) demolition of the existing intake and outfall structures, and (3) construction of a new intake and outfall structure to serve Units 3 and Unit 7.

Once-through cooling for Unit 7 could result in several potentially significant impacts to aquatic biological resources. Construction of the new combined intake structure for Unit 7 and Unit 3 would result in a permanent loss of about 0.24 acres of aquatic habitat. About 0.15 acres of the habitat (covering a linear distance of about 200 feet of shoreline) that would be permanently lost is concrete rubble that supports a relatively depauperate rocky intertidal community of barnacles, mussels, rock jingles, shore crabs, and algae. The remaining 0.09 acres that would be lost is shallow subtidal soft bottom habitat that supports a relatively diverse invertebrate community. The water column above these areas provides habitat for many species of fish, including Pacific herring and northern anchovy. Because San Francisco Bay is a unique estuarine ecosystem that supports many sensitive species, permanent loss of Bay habitat is considered a significant adverse impact.

Construction of the new discharge structures for Units 3 and 7 would result in the replacement of natural soft bottom Bay habitat by approximately 3.2 acres of artificial structures. Construction of these submerged structures would not preclude the use of Bay waters by species associated with the water column, and the structures themselves would provide additional habitat for hard bottom species and substrate for the deposition of herring eggs. Construction of the outfalls would result in the replacement of natural Bay bottom with artificial habitat. The construction of numerous piers, jetties, pipes, and other structures has resulted in a substantial cumulative loss of natural Bay soft bottom. Thus, the proposed new outfalls would add to cumulative losses of natural habitat in San Francisco Bay. As mitigation for this fill, the Applicant has discussed with the Port of San Francisco and the Bay Conservation and Development Commission staff the removal of the derelict Wharf 5 in the Pier 70 vicinity. Removal of artificial structures in the Bay would likely provide adequate mitigation for the proposed fill, although the details of this proposed mitigation have not yet been specified.

Entrainment[1]

The once-through cooling system for Unit 7 would circulate up to 227 million gallons per day (mgd) of Bay water through the cooling water system. The use of Bay water for Unit 7 would approximately double the 226 mgd currently permitted for the once-through cooling system of Unit 3. Because the number of larval fishes and planktonic invertebrates sucked through the cooling water system is directly proportional to the volume of water that passes through the system, once-through cooling for Unit 7 would approximately double the losses to entrainment of Unit 3, resulting in the additional loss of many million larval fishes, fish eggs, larval invertebrates, zooplankton, and phytoplankton.

Impingement[2]

Fishes and mobile invertebrates would also be lost by impingement at the combined Unit 3 and Unit 7 intake. The number of organisms impinged is related to several factors, including the volume of water passed through the intake and the design of the intake. The Unit 7 project includes replacement of the existing Unit 3 intake with a new combined Unit 3 and Unit 7 intake. The new intake would have several improvements over the existing Unit 3 intake, designed to reduce impingement. The approach velocity will not exceed 0.4 feet per second. In addition, the new combined Unit 3 and Unit 7 intake will have a continuously rotating inclined screen design to reduce the amount of debris buildup in front of the intake, which will reduce the number of organisms trapped in debris and allow more juvenile and adult organisms to avoid impingement. The Applicant also proposes to reduce impingement losses by implementing a fish return system equipped with a low-pressure spray wash. The actual impacts of impingement at the new intake cannot be determined until the new intake is constructed and impingement of aquatic organisms is documented.

Thermal Discharge

The discharge of heated effluent from the once-through cooling system may have adverse impacts on aquatic resources. The existing discharge sometimes results in a temperature elevation at the shoreline that is 10°F above ambient. Although the Unit 7 project would result in a greater discharge of heated effluent, the new combined Unit 7

[1] Entrainment occurs when small aquatic organisms (fish eggs, larvae, etc.) are carried on a destructive passage through the intake screens (screen mesh size usually 5/16 or 3/8 of an inch) and on through the remainder of the cooling system.

[2] Impingement of aquatic organisms occurs during cooling water intake as organisms are pulled into contact with the intake screens, and are held there by the velocity of the water being pumped through the cooling system.

and Unit 3 outfalls, which would have long diffuser sections discharging offshore, are expected to reduce the extent of the thermal plume. The thermal plumes from the new outfalls would not contact the shoreline. Therefore, the construction of a once-through cooling system for Unit 7 with new Unit 7 and Unit 3 outfalls may reduce existing thermal impacts.

Although shoreline impacts would be reduced with the new Unit 3 and Unit 7 outfalls, the thermal discharge would affect habitats farther out in the Bay than the existing discharge. The National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (CDFG) have expressed concern that temperature rises of 4°F or greater may have significant adverse impacts on listed salmonids. The project area is within Designated Critical Habitat for the Federal Threatened Central California Coast Evolutionarily Significant Unit of steelhead. Steelhead and Chinook salmon do not occur along the shoreline areas currently affected by the Unit 3 discharge. Therefore, moving the outfalls farther offshore would increase the chances that salmonids would come into contact with the thermal plume. Temperature rises exceeding 4°F are expected to be limited to the area immediately above each diffuser port and would not extend along the entire diffuser section. The volume of water with a temperature rise above 4°F would be small and discontinuous. Thus, impacts to listed salmonids of the thermal plumes from the proposed outfalls are unlikely, but cannot be discounted entirely. A steelhead or Chinook salmon could potentially contact the plume and suffer adverse effects, which might include interference with migration or disorientation that could lead to the affected individual becoming the victim of predation.

SOILS AND CONTAMINATION IMPACTS OF CONCERN

The new intake/outfall structures that would be constructed within the San Francisco Bay would require dredging activities of 5,900 yd^3 for the intake structure and 200 yd^3 for the outfall structure. Sampling from an offshore sediment survey conducted in January 2001 showed the presence of several contaminants: poly-aromatic hydrocarbons, total petroleum hydrocarbons, arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc. PCBs and pesticides were detected in a few of the samples. While mitigation measures would allow construction to be completed in these areas without significant impacts, the use of dry or hybrid cooling technologies would eliminate the need for any construction in these contaminated areas.

2 BACKGROUND ON COOLING OPTIONS

2.0 POWER PLANT OPERATION AND COOLING

Unit 7 at Potrero will supplement power currently generated by existing Potrero Units 3 (a 206 MW steam turbine) and Units 4, 5, and 6 (peaking turbines of 52 MW each). Unit 7 will be a state-of-the-art 540 MW natural gas-fueled combined cycle unit. The new unit will consist of two gas-fired turbines and one steam turbine.

The combined operation of Units 3 and 7 are expected to use a maximum of 453 million gallons per day (mgd) of seawater for once-through cooling. As part of the proposed Unit 7 project, the existing seawater intake structure for Unit 3 would be relocated, and a new outfall structure would be constructed.

Thermal power plants convert fuels (such as natural gas) to electrical power and waste heat. In combustion turbines, or Brayton cycles, almost all the waste heat is rejected in the exhaust gases. In steam turbines, or Rankine cycles, waste heat is rejected in the flue gases and in the condenser/cooling system. Operation of the cooling system for steam turbines serves three purposes: (1) condensing steam into water to allow pumping of a liquid instead of compressing a gas to raise the feedback to the boiler to high pressures; (2) recycling of the water back to the boiler to optimize water use; and (3) minimizing the steam turbine exhaust temperature to maximize the output of the steam turbine. The temperature of the heat sink and the heat transfer efficiency of the cooling system affect the overall plant performance. In the case of the Potrero Unit 7, the proposed cooling medium (or heat sink) is Bay water.

Combined cycle plants require less cooling than traditional fossil or nuclear steam power plants because only part of the electricity is generated from the steam cycle. In the case of the Potrero application, about 200 MW would be produced by the steam cycle. The combustion (gas) turbine parts of the combined cycle plant would not need water for cooling.

Historically, power plants were built along the coast to make use of seawater for cooling. Once-through cooling has low capital and operating costs and potential for high power plant operating performance (i.e., lower temperature heat sink), so it is still favored by plant developers. In once-through cooling, water is drawn from a local source (i.e., the ocean), passed through the condenser tubes, and returned to the ocean at a higher temperature. Although large volumes of water are required, once-through cooling does not consume water; it uses the water briefly and returns the water at an elevated temperature. Steam is condensed in a shell-and-tube condenser.

The environmental impacts of once-through cooling include impingement and entrainment of aquatic organisms and raised temperature of the cooling water when it is returned to the receiving water (thermal discharge). Because there have long been concerns about the impacts of once-through cooling and this cooling technology is dependent on an open water source, power plant designers have developed other cooling systems to replace once-through cooling. This chapter briefly describes the three cooling technologies that can be used to replace once-through cooling: dry cooling, wet cooling[3], and hybrid cooling systems. For each of the cooling technologies, this chapter provides general background information, conceptual design information, and discusses possible environmental effects of the cooling technologies for the project site.

2.1 DRY COOLING

Description of the Process and Equipment Required

There are two types of dry cooling systems: direct dry cooling and the lesser used indirect dry cooling. In both systems, fans blow air over a radiator system to remove heat from the system via convective heat transfer (instead of once-through cooling or evaporative heat transfer). In the direct dry cooling system, also known as an air-cooled condenser (ACC), steam from the steam turbine exhausts directly to a manifold radiator system that rejects heat to the atmosphere, condensing the steam inside the radiator. This is shown in **POTRERO UNIT 7 COOLING OPTIONS Figure 1**. Direct dry cooling is analyzed in this report.

Indirect dry cooling uses a secondary working fluid (in a closed cycle with no fluid loss) to help remove the heat from the steam. The secondary working fluid extracts heat from the surface condenser and is transported to a radiator system that is dry cooled (fans blow air through the radiator to remove heat from the working fluid). Because indirect dry cooling is not very common and does not appear to have any strategic advantages at the Potrero power plant, it will not be further analyzed in this report.

Historic, Current, and Proposed Use of Dry Cooling

Dry cooling was first used in 1938 for a vacuum steam turbine installed in a power plant in Germany (Guyer, 1991). By 1971, 14 power plants worldwide had been equipped with condensers with direct dry cooling. The largest installation at that time was a roof-mounted unit for a 160 MW power plant in Utrillas, Spain. By 1991, dry cooling was being used at approximately 40 power plants worldwide with generating capacities greater than 100 MW. Since that time, use of dry cooling has also increased significantly around the world and in the United States (Guyer, 1991; USEPA, 2001; Maulbetsch, 2001).

The largest dry-cooled system in the world today is the Matimba plant in South Africa, which began operating in 1991. It represented a major scale-up of dry-cooled technology, using direct dry cooling for six 660 MW units.

One of the newest power plants in California was constructed as a dry-cooled facility. The Sutter Power Plant, constructed by Calpine Corporation, is a 540 MW, natural gas-fired, combined cycle facility. The combined cycle design consists of two combustion turbine generators (CTGs), two heat recovery steam generators (HRSGs) with duct

[3] Wet cooling without plume abatement is not evaluated as an alternative in this study due to the anticipated large vapor plume that would result due to the climate conditions in the Potrero area, but the technology is briefly described, and a plume abated system (hybrid cooling) is fully analyzed.

burners, and a steam turbine generator (STG). The Sutter Power Plant uses a 100% dry cooling design that will reduce groundwater use by over 95% from the original proposal of 3,000 gallons per minute (gpm) to a revised annual average of less than 140 gpm. The five percent of the water that is used represents the make-up for the steam cycle, which is not used for cooling. The dry cooled plant is a zero effluent discharge facility and does not discharge any process fluids.

The Energy Commission also permitted a 240 MW co-generation facility with dry cooling in Crockett in 1996. The Crockett Co-Generation Plant uses 12 fans to cool the steam output from the 80 MW steam turbine. Energy Commission staff visited the facility in June 2000 and found the dry cooling to be operating as expected, with no major problems. Two other dry-cooled facilities have recently been or are currently being evaluated by the Energy Commission:

- Reliant Energy has proposed a dry-cooled facility, the 500 MW Colusa Power Project. This project is currently undergoing environmental review by the Energy Commission.

- The Otay Mesa Generating Project (OMGP), a 510 MW natural gas-fired combined cycle power plant with dry cooling, will be located in western San Diego County. The Energy Commission approved this project in April 2001.

Dry cooling is also a common technology for power plants in Nevada. Currently, the El Dorado Energy Project is the only operational air-cooled power plant facility in the State of Nevada. This 480 MW combined cycle facility is located in Boulder City. Two other combined cycle air-cooled power plants are currently under construction in Nevada: the Duke Energy 1,200 MW Moapa Energy Facility (approximately 20 miles northeast of Las Vegas in Apex Industrial Park) and the 575 MW Big Horn Power Plant (in Primm, southwest of Las Vegas). In addition, there are four combined cycle air-cooled power plants proposed to be constructed in Nevada. These facilities include: Apex Generating Station (1,100 MW), Arrow Canyon (575 MW), and Silver Hawk (570 MW) facilities at the Apex Industrial Park, and the Copper Mountain Power Facility (600 MW) in Boulder City.

Energy Commission staff researching the use of dry cooling have seen that the use of dry cooling technology is expanding rapidly, and the sizes of the plants are also increasing. It is estimated that there are over 2,500 MW of U.S. power generated using dry cooling, and approximately 15 to 20 GW worldwide.

POTRERO UNIT 7 COOLING OPTIONS Photos 1 and 2 (at the end of this section) show examples of dry cooling installations.

Advantages and Disadvantages of Dry Cooling

Dry cooling is the best choice of cooling technologies for a steam power plant in terms of water conservation and wastewater minimization. However, this technology can raise other environmental and economic issues, depending on the location and specific situation (these are reviewed in detail for the Potrero site in Chapter 4 of this report). The following is a general list of the advantages and disadvantages of dry cooling.

Advantages of Dry Cooling Systems

- Not water dependent so plant location is not tied to a water source (essentially no water intake or water discharge requirements).
- Minimizes the use of water treatment chemicals.
- Minimizes the generation of liquid and solid wastes.
- Does not generate visible plumes that are commonly associated with wet cooling towers.
- Eliminates impacts to aquatic biological resources.
- Reduces the number of permits and potential permit delays.

Disadvantages of Dry Cooling Systems

- Requires large air-cooled condensers that could have negative visual effects.
- Compared to once-through cooling, requires the disturbance of upland areas for the air-cooled condensers.
- Can creat greater noise impacts than once-through or wet cooling systems because of operation of large fans. Fan configuration can be modified and other mitigation measures implemented to reduce noise.
- Using dry cooling, the power plant steam cycle efficiency and output can be slightly reduced, depending on site conditions and seasonal variations in ambient conditions. Also, extra power is needed to operate the cooling fans.
- Capital costs for building air-cooled condensers are generally higher than capital costs for once-through cooling.

2.2 WET COOLING

Description of the Process and Equipment Required

Wet cooling systems use about 5% of the water used by once-through cooling systems. The water removes waste heat from the system through the cooling towers, and the water is recirculated. In wet cooling systems, process heat is removed by evaporation each time the water is cycled through the system. **POTRERO UNIT 7 COOLING OPTIONS Figure 2** shows how a typical wet cooling system operates.

The cooling system must be replenished with "make-up water" to replace water "lost" (or consumed by) to evaporation, blowdown[4], and drift. The cooling system takes advantage of evaporation to remove heat, but cooling system water is consumed through evaporation. Evaporation causes the concentration of impurities. Blowdown volumes are dependent on the quality of the make-up water and the system specifications regarding the impurities that are in the make-up water. Other methods of conserving water can be used, such as reverse osmosis (RO). **POTRERO UNIT 7 COOLING OPTIONS Photo 3** is a close-up view of mechanical draft cooling towers.

[4] Blowdown is the bleeding off of a small percentage of the total flow, so that the new more pure make-up water balances the impurities so that the water quality in the system stays within specifications.

Current Uses of Wet Cooling

Wet cooling is one of the most common technologies in the world for the removal of waste heat, including many applications at power plants. Wet cooling towers are a major tool in heat removal from the approximately 500 billion gallons a day used by U.S. industries (Burger, 1994).

Advantages and Disadvantages of Wet Cooling

The following is a general list of the advantages and disadvantages of wet cooling.

Advantages of Wet Cooling Systems

- Uses only about 5% of the water required for a once-through cooling system.
- Once a wet cooling system is filled, the only water withdrawn from the environment is makeup water to replace water lost to evaporation, blowdown and drift.
- Removes heat by the evaporation of a small fraction of the recirculating water.
- Can reach "wet bulb" temperatures, which are generally lower than "dry bulb" temperatures, thus improving cooling efficiency in comparison to dry cooling systems.

Disadvantages of Wet Cooling Systems

- Requires a dependable source of water.
- Although more efficient than dry cooling, the power plant steam cycle efficiency and output can be slightly reduced with wet cooling systems when compared to once-through cooling systems, depending on site conditions and seasonal variations in ambient conditions.
- Requires water treatment and monitoring to control concentrations of impurities.
- Can produce water vapor plumes that have negative aesthetic effects.
- Capital and maintenance costs for wet cooling systems are generally higher than these costs for a once-through cooling system.

2.3 HYBRID (WET/DRY) COOLING

Description of the Process and Equipment Required

Hybrid cooling systems combine wet and dry cooling technologies. The two primary hybrid systems are water conservation and plume abatement designs. These hybrid systems can vary depending upon the unique situation and objectives (Burns, 2000).

Water conservation designs reduce water usage for plant heat rejection. Water is primarily used during the hottest periods of the year to reduce the large losses in steam cycle capacity and plant efficiency that occur with all-dry systems. The hybrid water conservation systems can limit water use to only 2% to 5% of that required for all-wet systems while achieving substantial efficiency and capacity advantages during the peak load periods of hot weather. If more water is available, it can be used to further increase plant efficiency.

Another water conservation hybrid approach is Spray-Enhanced Dry Cooling. In these systems, the exhaust steam is pre-cooled with spray before it reaches the air-cooled condenser. This system uses 25% of the water used for all-wet cooling, but reduces the capacity loss that occurs with all-dry cooling (Maulbetsch, 2001).

The most common type of hybrid system is the hybrid plume abatement system. Plume abatement towers are very similar to all-wet systems, but they also add a small amount of dry cooling to dry out the tower exhaust plume during cold, high-humidity days when the plumes would be very visible. POTRERO UNIT 7 COOLING OPTIONS Figure 3 shows the similarities between wet towers and hybrid plume abatement towers. On an annual basis, the hybrid plume abatement towers can use from 95% to 99% of the water quantity used in conventional wet cooling system. The goal of the plume abatement towers is to achieve high plant efficiency similar to the wet towers, but with reduced plumes.

Current Use of Hybrid Cooling

Plume abatement wet/dry towers have been used since the 1970s with proven reliability. The parallel condensing cooling systems (with both a wet tower and a dry cooling tower) have been used since at least since the late 1980s. GEA Power Cooling Systems is one vendor that provides a parallel condensing system called the PAC Parallel Condensing System. This system combines reliable wet cooling and dry cooling tower technologies.

Advantages and Disadvantages of Hybrid Cooling

The following is a general list of the advantages and disadvantages of parallel condensing hybrid cooling.

Advantages of Parallel Condensing Hybrid Cooling Systems

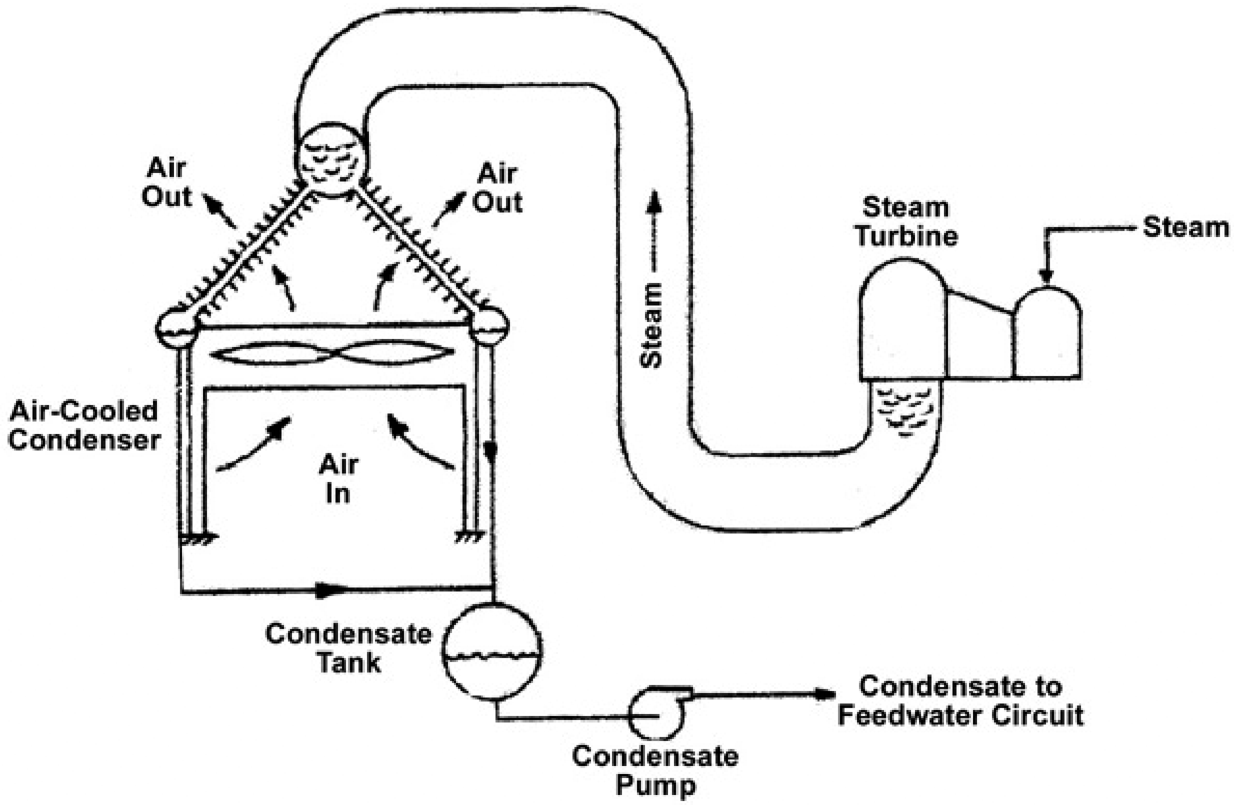
- Water conservation hybrid systems use only 20% to 80% of the water consumed by wet towers.
- Once a parallel condensing hybrid cooling system is filled, the only water withdrawn from the environment is makeup water to replace water lost to evaporation, blowdown and drift. Water loss is less than the water loss from all-wet cooling systems.
- Parallel condensing hybrid cooling can reach “wet bulb” temperatures in the wet portion of the system. These wet bulb temperatures are generally lower than “dry bulb” temperatures, thus improving cooling efficiency in comparison to an all-dry cooling systems.
- Because of the lowered water requirements, parallel condensing hybrid cooling systems can avoid the use of seawater when available fresh or recycled water may not be sufficient to meet the demands from an all-wet cooling system.

Disadvantages of Parallel Condensing Hybrid Cooling Systems

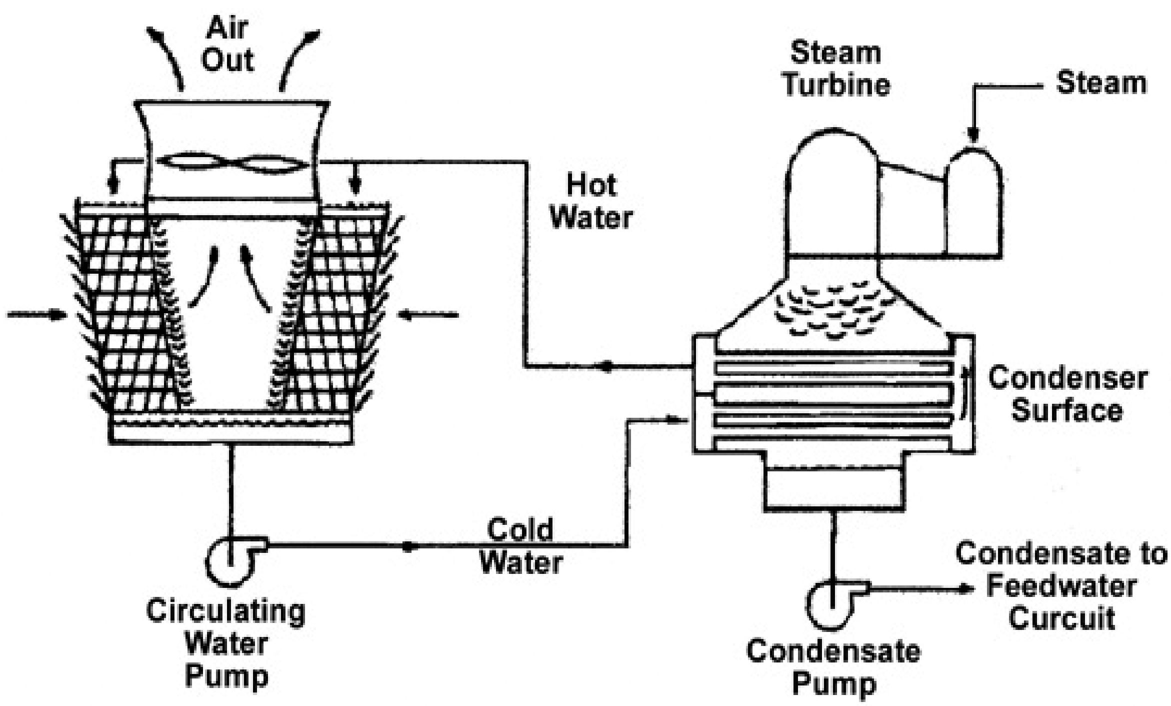
- Requires a dependable source of water.

- Although more efficient than dry cooling, the parallel condensing hybrid cooling system would not be as efficient at once-through or wet cooling.
- Requires water treatment and monitoring to control concentrations of impurities.
- Can produce water vapor plumes that have negative aesthetic effects.
- Capital and maintenance costs for parallel condensing hybrid systems are generally much higher than once-through or wet systems.
- Require large air-cooled condensers and wet cooling towers that could have negative visual effects.
- Compared to once-through cooling, parallel condensing hybrid cooling systems dry cooling requires the disturbance of upland areas, for the air-cooled condensers and wet cooling towers.

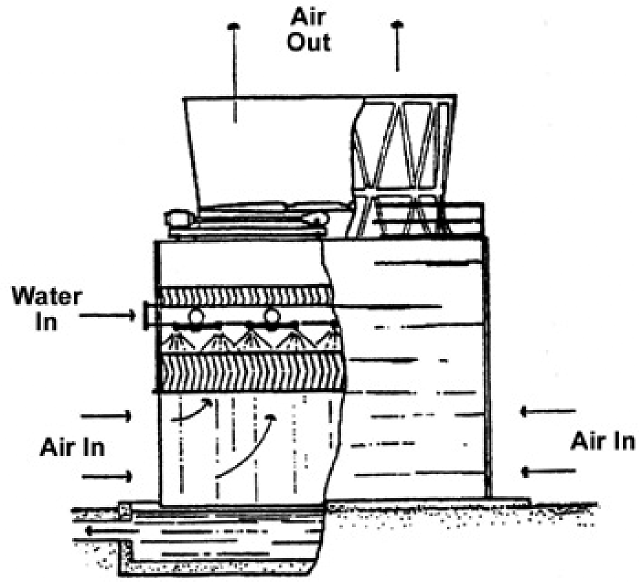
POTRERO UNIT 7 COOLING OPTIONS Figure 1
Diagram of Direct Dry Cooling System



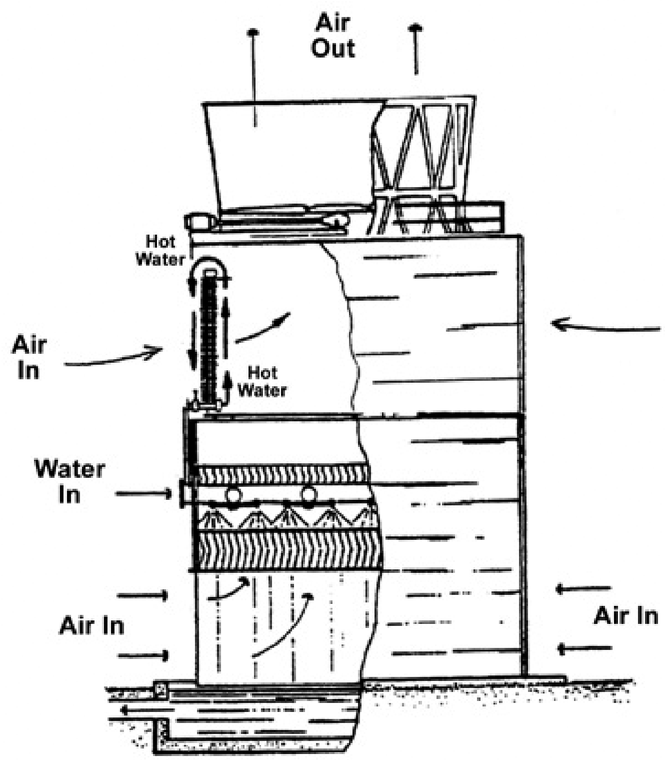
POTRERO UNIT 7 COOLING OPTIONS Figure 2
Wet Cooling System with Surface Condenser and Mechanical Draft Cooling Tower



POTRERO UNIT 7 COOLING OPTIONS Figure 3
Comparison Drawings of a Wet Tower and a Hybrid Plume Abatement Tower



WET COOLING TOWER



WET/DRY (PLUME ABATEMENT) COOLING TOWER

POTRERO UNIT 7 COOLING OPTIONS Photo 1
Mid-Distance View of Dry Cooling System at the Sutter Power Plant
(Shown within the box.)

POTRERO UNIT 7 COOLING OPTIONS Photo 2
Close-Up View of the Dry Cooling System at the Sutter Power Project

POTRERO UNIT 7 COOLING OPTIONS Photo 3
Close-Up View of Mechanical Draft Cooling Towers
(Shown within the box.)

3 CONCEPTUAL DESIGN OF COOLING OPTIONS FOR THE POTRERO POWER PLANT

3.1 DESCRIPTION OF THE PROPOSED PROJECT

Unit 7 is proposed to be a combined cycle electric generating unit consisting of two General Electric Frame 7F combustion turbines (CTGs) and one steam turbine generator (STG). The combustion turbines will draw in air through a compressor section and add natural gas for purposes of combustion. The resulting hot gases will expand through a power section of the CTGs and drive electric generators. The hot exhaust gases are then passed through two heat recovery steam generators (HRSGs) to produce steam that is directed to a single STG driving and additional electric generator. After expansion through the STG the now low-pressure steam must be condensed back to water to be pumped again the through the HRSGs.

The applicant has proposed the use of a once-through cooling system for Unit 7. This would consist of drawing water from the San Francisco Bay through a shoreline intake structure, passing it through the power plant condenser to cool the steam discharged by the steam turbine portion of the plant and then discharging the heated water back to the bay via discharge pipes that extend some 900 feet offshore.

Section 3.2 describes cooling technologies studied in this report. Section 3.3 describes the design of a dry cooling system, and Section 3.4 describes the hybrid system. Chapters 4 and 5 of this report present an analysis of the environmental and engineering impacts of these cooling technologies.

3.2 COOLING TECHNOLOGIES CONSIDERED

As a result of the potential biological impacts that may occur with once-through cooling design (see Chapter 1), Energy Commission Staff has reviewed alternative cooling technologies as possible alternatives to once-through cooling. These technologies would not require the use of any water from the San Francisco Bay for power plant cooling. Two types of alternative cooling technologies are considered:

1. A dry or air-cooled condenser that transfers the heat from the steam turbine exhaust directly to the atmosphere (therefore neither drawing nor discharging water from the Bay).

2. A hybrid (wet-dry) cooling tower using treated reclaimed water and combines the dry with a wet cooling tower technologies to cool the plant STG exhaust. It is the staff's position that makeup water requirements for the cooling tower options should not come from freshwater sources. Therefore, this analysis considers makeup water from the nearby Southeast Water Pollution Control Plant (SWPCP) for use in the hybrid cooling system.

A third cooling technology was also considered: a straight wet cooling system using treated reclaimed water. However, the third alternative has been eliminated from further consideration because it would emit highly visible vapor plumes when the ambient temperature is cool and the relative humidity is high. Because these conditions are quite common at the Potrero site, and frequent vapor plumes would not be considered acceptable in this location, a wet cooling alternative was not evaluated.

The dry and hybrid cooling systems addressed herein would have no effect on the existing intake and discharge systems for Unit 3. It is presumed in this analysis that the existing intake and outfall would be unchanged.

3.3 DRY COOLING

Design Criteria

In order to compare the performance and impacts of a dry or air-cooled condenser (ACC) with that of the once-through system, the operating conditions at a common design point must be established. The design and operation of an ACC is highly dependent upon the ambient conditions at a specific site. Therefore, design criteria that are based on expected site conditions have been established upon which to base the conceptual design. For purposes of this analysis the design conditions set forth in the applicant's Application for Certification were used for comparison. A final design and optimization for these criteria would be necessary if the dry alternative were to be selected as the preferred alternative.

POTRERO UNIT 7 COOLING OPTIONS Table 1 shows the criteria used in the design of the air-cooled system.

POTRERO UNIT 7 COOLING OPTIONS Table 1
Potrero Unit 7 Dry Cooling Tower Conceptual Design Criteria

Parameter	ISO*	Winter	Summer
Site Elevation	25 feet	25 feet	25 feet
Dry Bulb Temp[5]	59°F	35°F	80°F
Wet Bulb Temp[6]	51.5°F	30°F	63.5°F
Relative Humidity	60%	50%	40%
Steam Flowrate (lb/hr)	1,115,379	1,399,927	1,371,605
Steam Turbine Exhaust Temp	109°F	85°F	130°F
Enthalpy (Btu/lb)	1118	1109	1098
Backpressure	less than 5”Hg	less than 5”Hg	less than 5”Hg

* International Standards Organization.

[5] Dry bulb temperature is the temperature as indicated by an ordinary thermometer, without accounting for humidity in the air.

[6] Wet bulb temperature accounts for the relative humidity in the air (the largest differences between wet and dry bulb temperatures would occur in very dry conditions).

Using the above criteria a single design point was selected that reflected the site conditions considered to be reasonable for purposes of this analysis. The design point used assumed the following conditions:

- Steam flow 1,371,605 pound per hour
- Steam quality 100%
- Inlet air temperature 80°F
- Turbine backpressure 4.53 in Hg

Size, Configuration and Layout

The size of the ACC is a function of the heat load from the steam turbine generator and the ambient conditions. As described in Chapter 2, the ACC is comprised of tube bundles with fins attached to the tubes to enhance heat transfer to the air. These bundles are grouped together and mounted in an A-frame configuration on a steel support structure. These A-frame tube bundles are lined up into rows or bays. The steam is ducted directly from the steam turbine exhaust to the ACC where it enters in a parallel flow into the tubes across the top of the bays. Air is blown from below across the finned tube bundles by a series of large fans. The fans are located beneath the A-frame tube bundles with each fan considered as a module. To accommodate the large mass of air required for cooling the steam, the A-frame tube bundles are elevated on top of an open structure. As the steam passes down through the tube bundles, it is condensed. The condensate drains by gravity flow into a tank and is then pumped back to the HRSG. Since the steam is exhausted directly from the steam turbine generator after it has expanded through the turbine, it is at a very low pressure and thus a large volume. This condition limits the distance that the ACC can be located from the steam turbine generator due to the drop in pressure that results during the transport of the steam.

For the Potrero site, the preliminary design configuration using the above stated design criteria resulted in the following design parameters for the ACC:

- No. of bays 7
- No. of fans per bay 5
- No. of fan modules 35
- Fan diameter 32 feet
- Height to top of steam duct 108 feet
- Main steam duct diameter 20 feet

The factors require an ACC with a plot area of 269 feet by 192 feet. Within the existing plant boundary, there is only one location large enough to accommodate these ACC space requirements. This location, Dry Cooling Alternative One, is directly west of existing Unit 3 near the southern boundary of the plant site. The plan and elevation of Dry Cooling Alternative One are shown on **POTRERO UNIT 7 COOLING OPTIONS Plates 1 and 2** (at the end of this chapter).

While the ACC can physically fit into this space, the condenser would then be located over 500 feet away from the steam turbine. This distance raises concerns because the manufacturers' general recommended criteria limit the length of the steam pipe to about

200 feet[7]. Consideration was given to relocation of the steam turbine generator closer to the air-cooled condenser and piping the high-pressure steam the longer distance. While this configuration is functionally feasible, it would require further engineering evaluation due to lengths of high pressure steam piping, condensate return piping, location of electrical interconnections, as well as operational constraints of operating components of the system spread over relatively large distances.

Due to the potential operational problems with Dry Cooling Alternative One, a second location for the ACC, Dry Cooling Alternative Two, has also been considered. Dry Cooling Alternative Two would allow the air-cooled condenser to be located closer to the steam turbine generator. The ACCs in this case would be located north of the plant entrance road and west of the existing fuel oil tanks on property currently owned by Pacific Gas and Electric Company. To accommodate this site the steam turbine generator would be relocated north of the combustion turbine generators that would in turn be moved further south (reversing their positions proposed). The plant entrance road would either be rerouted or built to cross the large steam duct. **POTRERO UNIT 7 COOLING OPTIONS Plates 3 and 4** (see end of this Chapter) show the layout and elevation of Dry Cooling Alternative Two.

Heat Balance

The amount of power that the steam turbine can produce is directly related to its exhaust pressure. Simply stated, the higher the temperature and pressure of the steam entering the steam turbine generator, the more energy or potential for work it contains. Correspondingly, the lower the temperature and pressure of the steam exhausted into the condenser, the greater the amount of energy extracted from it to produce electricity. Therefore, the colder the cooling source for the condenser, the greater the potential output of the steam turbine generator. When using the ACC, the ambient dry bulb temperature of the atmosphere directly controls the condensing temperature. Because the ACC cannot bring the temperature of the steam to match that of the ambient dry bulb, there is always a difference between the turbine exhaust temperature and the outside temperature. This difference is called the Initial Temperature Difference (ITD). Generally the ITD will be on the order of 50°F. Thus for the ambient temperature of 80°F the steam turbine exhaust temperature would be 130°F. This temperature translates directly to the pressure within the condenser or backpressure of the turbine. For a turbine operating with an air-cooled condenser at the above stated deign conditions, the backpressure would be 4.53 inches of mercury (in HgA). This would compare to the backpressure of the once-through case of approximately 1.46 in HgA. Since a colder cooling water condensing source translates to a greater output for the steam turbine, it is estimated that using the air-cooled condenser will result in a reduction of output from the STG of approximately 7 to 10 MW.

Auxiliary Loads

The ACC requires additional power to operate the 35 fans used to circulate air over the tube bundles. Each fan has a diameter of 32 feet and is driven by a 200 horsepower

[7] While the manufacturer's standard recommendation is that the steam pipe not exceed 200 feet, potential engineering measures would need to be evaluated to determine whether dry cooling would be feasible at the Potrero site.

motor. All together, the total shaft power required to operate the fans comes to 5,815 kW. This however, is somewhat offset by the fact that the ACC does not have a requirement to circulate cooling water through condenser tubes as does the once through alternative. Based on the applicants proposed design there would be two 79,000 gpm pumps used to provide the cooling water to Unit 7. It is estimated that these pumps will require approximately 1,500 kW each. Thus the net increase in auxiliary power requirements for the air-cooled condenser case is approximately 3-5 MW.

Efficiency

With an ACC, two factors cause a reduction in plant output as compared with a once-through cooling system. First, the higher condenser backpressure causes a loss of power generated by the steam turbine. Second, auxiliary loads from the fans also require power for their operation. Using the once-through case as the basis for comparison, the plant will burn 191,664 pounds per hour of natural gas at the summer design point using supplemental duct firing. The fuel use is measured in British Thermal Units (Btus); therefore, the units used to portray the efficiency of a power plant are Btus per kWhr. This is identified as the plant heat rate. Generally, a combined cycle similar to the Potrero plant will have a net plant heat rate of approximately 7,000 Btu/kWhr.

Assuming this as the base for the once-through design and assuming an equivalent fuel consumption for the dry cooling alternative, the heat rate of the plant would increase reflecting a decrease in efficiency due to lower net output of the Unit 7. This lower output is caused by a the combination of reduced steam turbine generator output due to the higher condenser back pressure and the greater auxiliary loads due the requirement of the air-cooled condenser fans. Thus the new plant heat rate would be approximately 7,172 Btu/kWhr or an increase of approximately 2.5%.

Cost

[This section will be presented in the FSA when cost calculations are completed]

3.4 HYBRID (WET/DRY) COOLING

Design Criteria

The design and operation of the hybrid cooling alternative is also highly dependent upon the ambient conditions at the specific site location. Therefore, a set of design criteria consistent with that established for the dry alternative and the AFC has been applied to establish a conceptual design. These criteria are not intended to form the final design basis but are used for comparative analysis only. If the hybrid cooling alternative were to be selected, further optimization for these criteria would be necessary.

POTRERO UNIT 7 COOLING OPTIONS Table 2 shows the conceptual design criteria used for the analysis of the hybrid case.

POTRERO UNIT 7 COOLING OPTIONS Table 2
Hybrid Cooling Tower Conceptual Design Criteria

Parameter	ISO*	Winter	Summer
Site Elevation	25 feet	25 feet	25 feet
Dry Bulb Temp	59°F	35°F	80°F
Wet Bulb Temp	51.5°F	30°F	63.5°F
Relative Humidity	60%	50%	40%
Steam Flowrate (lb/hr)	1,115,379	1,399,927	1,371,605
Cooling water flowrate (gpm)	148,000	148,000	148,000

* International Standards Organization.

Using the above criteria a single design point was selected that reflected the site conditions considered to be reasonable for purposes of this analysis. The design point used assumed the following conditions.

- Steam flow 1,371,605 pound per hour
- Steam quality 100%
- Coldwater temp 70°F
- Hot water temp 90°F
- Turbine backpressure 1.8 in Hg

Water Supply

The hybrid cooling alternative is comprised of a combination wet cooling tower with a dry section mounted on top for purposes of abating the visible vapor plume that would occur during periods of cool, high humidity weather. The concept of this design is to use the wet portion of the tower to provide a primary cooling source for the cooling water that is circulated through the plant condensers and then a dry portion to reheat the exiting air to a temperature above which a vapor plume will not form.

A hybrid configuration for cooling Unit 7 will require water to makeup losses through evaporation, drift, and blowdown from the tower. As water passes over the wet portion of the hybrid tower, some of it will be evaporated and thus require replacement. Additionally, due to the evaporation losses the remaining water will increase in mineral content, which would eventually deposit on the tower reducing its effectiveness. To avoid this a portion of the water is discharged or blowndown and replaced with treated reclaimed water. Also, some of the water is lost as a mist (called “drift”) that is carried up as a result of the airflow through the tower. By use of specifically designed drift eliminators, this loss is reduced to 0.0005% of the cooling water flow.

The sum of these losses must be made up with the addition of the treated reclaimed water. The source of make up water would be from the City of San Francisco’s Southeast Water Pollution Control Plant (SWPCP). Currently, the SWPCP treats wastewater to a secondary level prior to discharge to the San Francisco Bay. Secondary effluent is not suitable for use in the cooling tower without filtration and disinfection to meet California Code Regulations Title 22 standards for turbidity and coliform content. Therefore, additional water treatment will be required before use in the cooling tower. It is estimated that the average makeup requirement for the Potrero Unit 7 will be 3.5 to 4 million gallons per day. The SWPCP facility has the capability to treat approximately 65 million gallons per day of wastewater.

The SWPCP is located approximately 1.2 miles from the plant and would require the construction of a new delivery pipeline estimated to be 16 inches in diameter and a return pipeline of 8 inches in diameter. The return line would transport the cooling tower blowdown back to the SWPCP for treatment. The route of these pipelines would be along Third Street and pass under the Islais Creek Channel. Subject to an agreement between the City of San Francisco and Mirant the additional treatment facilities could be located either at the SWPCP or possibly at or near the project site.

The additional treatment of the secondary effluent would employ physical and chemical methods to produce water suitable for use in the cooling tower. The reclaimed water pretreatment system would use microfiltration equipment as the central technology. The microfiltration process would significantly lower the turbidity and total suspended solids (TSS) levels in the water. In a microfilter, the water is pressurized and forced through micropores removing many forms of TSS, virus, and bacteria typically found in secondary treated effluent.

In addition to solids, dissolved phosphorus is removed from the secondary effluent water in the microfiltration process. Phosphates are removed as a means of limiting microbiological activity in the cooling tower makeup water. Phosphate removal is achieved by injection of alum upstream of the microfilter to precipitate aluminum phosphate solids. These solids are then removed by the microfiltration membranes. Sulfuric acid is also added to promote the efficiency of the precipitation process. The microfiltration equipment is backwashed on a regular basis to clean the membranes. The backwash water is combined with the cooling tower blowdown and returned to the SWPCP. With some further treatment, the secondary treated reclaimed water could also be used in place of city water as makeup to the boiler feedwater. This would reduce Unit 7's use of potable water for nonpotable uses, which would be considered an "unreasonable" use under the California Water Code when reclaimed water is available.

According to SWPCP staff, the SWPCP is shutdown for maintenance 12 times per year, with the longest duration being 22 hours. This would necessitate Unit 7 being provided with sufficient storage to continue operation during these periods. Storage facilities for 3.5 to 4 million gallons of water would be required either at the SWPCP, at the Potrero Power Plant site, or both.

Size, Configuration, and Layout

The configuration of a hybrid cooling tower combines finned tube heat exchangers, dry sections and conventional evaporative cooling, or wet sections using fans to draw the air through the tower. Air is drawn in parallel through both the air-cooled section and the evaporative section. As the air passes through the wet section of the tower it picks up moisture. If the moisture in the air reaches saturation it forms a vapor and a plume becomes visible, which can be eliminated by mixing the moist air with dry air from the dry section, thus keeping it from becoming saturated. Therefore, the tower consists of a lower wet section where water droplets are passed over fill material, and finned tubes above. From a distance the tower appear much like a radiator. On top of these sections is the deck where the fans are located within housings that extend above the deck.

The size of the hybrid cooling tower is a function of the heat load and the ambient conditions at the site. For the Potrero site, the assumed design point near the summer conditions was used. This results in a tower that is approximately 500 feet long by 50 feet wide and approximately 56 feet high to the fan deck and 70 feet to the top of the fan housing. The tower would consist of 10 fans approximately 30 to 32 feet in diameter that would draw air up through the wet and dry sections of the cooling tower. Each fan services one cell of the cooling tower. This design and its location are illustrated in **POTRERO UNIT 7 COOLING OPTIONS Plates 5 and 6**.

The cooling tower location would be located along the southern boundary of the Potrero property. Cooling water would be piped to the steam turbine condenser located directly below the turbine. After circulating the cooled water through the condenser, the water is returned to the cooling tower to be cooled again by evaporation.

Heat Balance

Since the hybrid plume-abated tower takes advantage of the effects of evaporation, it has the capacity to reduce the temperature of the cooling water to a point closer to the wet bulb ambient temperature. This allows the steam turbine generator to operate more efficiently than with a straight dry cooling system. Generally, the cooling water can be brought to within 8°F of the ambient wet bulb temperature and the steam turbine exhaust to within 6°F of the return cooling water temperature. This would result in the condenser operating at a temperature of 97.5°F. At this temperature the backpressure of the turbine would be 1.8 in Hg. This would compare to the backpressure of the once-through case of approximately 1.46 in HgA. The differential in output between the once-through cooling water system and the hybrid cooling alternative is a loss of approximately 1.5 MW for the average summer condition. This difference would be greater during periods of extreme ambient temperatures.

Auxiliary Loads

The hybrid cooling system requires additional power to operate the 10 fans used to circulate air through the tower. Each fan has a diameter of 30 to 32 feet and is driven by a 200 horsepower motor. Altogether, the total shaft power required to operate the fans comes to approximately 1,500 kW. Since both the wet/dry cooling tower and once-through system require circulating water pumps, these loads are considered to be close to equal. There would also be some additional power requirements to pump the makeup water from the SWPCP to Potrero and return the cooling tower blowdown.

Efficiency

The higher condenser back pressure and corresponding loss of power generated by the steam turbine plus the additional auxiliary loads from the fans and water pumping requirements would reduce the efficiency of the overall power generation cycle for the hybrid system. The measure of power plant efficiency is the comparison of the amount of fuel required to generate a kilowatt-hour of electricity. Using the once-through case as the basis for comparison, the plant will burn 191,664 pounds per hour of natural gas at the summer design point using supplemental duct firing. The fuel use is measured in British Thermal Units or Btus therefore the units used to portray the efficiency of a power plant are Btus per kWhr. This is identified as the plant heat rate.

Generally, a combined cycle plant like Potrero would have a net plant heat rate of approximately 7,000 Btu/kWhr. Assuming this as the base for the once-through design and assuming an equivalent fuel consumption for the wet/dry cooling alternative, the heat rate of the plant would increase reflecting a decrease in efficiency due to lower net output of the Unit 7. This lower output is caused by a the combination of reduced steam turbine generator output due to the higher condenser back pressure, the greater auxiliary loads due to the requirement of the wet/dry cooling tower fans and the additional pumping requirements for delivery of the makeup water. The power requirements for the pumping load associated with delivery of the reclaimed water have not been included in this estimate since it is unknown at this time if it will be included with the agreement to provide the water. Thus the new plant heat rate is estimated to be approximately 7034 Btu/kWhr or an increase of approximately 0.5 to 1%.

Cost

[To be added to FSA when calculations are completed.]

3.5 COST OF ONCE-THROUGH COOLING IMPROVEMENTS

As part of the proposed project, Mirant intends to relocate the intake for both Units 3 and 7 and construct a new outfall structure. [Cost and description will be added here for FSA when calculations are completed.]

POTRERO UNIT 7 COOLING OPTIONS Plate 1
Dry Cooling Alternative One – Site Plan
(Not to Scale)

SEE PDF FILE

POTRERO UNIT 7 COOLING OPTIONS Plate 2
Dry Cooling Alternative One – Elevations
(Not to Scale)

SEE PDF FILE

POTRERO UNIT 7 COOLING OPTIONS Plate 3
Dry Cooling Alternative Two – Site Plan
(Not to Scale)

SEE PDF FILE

POTRERO UNIT 7 COOLING OPTIONS Plate 4
Dry Cooling Alternative Two – Elevations
(Not to Scale)

SEE PDF FILE

POTRERO UNIT 7 COOLING OPTIONS Plate 5
Wet/Dry Cooling Alternative – Site Plan

(Not to Scale)

SEE PDF FILE

POTRERO UNIT 7 COOLING OPTIONS Plate 6
Wet/Dry Cooling Alternative – Elevations

(Not to Scale)

SEE PDF FILE

PLEASE NOTE: Some of the following draft discussions reference other draft technical sections that will be part of the Final Staff Assessment (FSA) which is expected to be issued in late-January 2002. The draft technical sections are not available for Therefore, both the technical sections referenced and the following discussions are subject to change.

4 ENVIRONMENTAL ANALYSIS OF COOLING OPTIONS

4.1 AIR QUALITY

Introduction

Air pollutant emissions result from the construction and operation of any type of cooling tower. Construction emissions of concern are those from equipment exhaust and fugitive dust, while operational impacts include particulate matter (PM10 and PM2.5) from the cooling tower drift. This section identifies the potential air pollutant emissions and air quality impacts of using dry cooling or hybrid cooling systems.

Air Emissions and Impacts of Dry Cooling

Emissions from the construction of the dry cooling tower would be different than from the construction of the proposed once-through cooling system. Additional sections of the project site would be disturbed for the cooling towers and the laydown area(s) may have to be larger to store and/or prepare the air-cooled radiator components prior to installation. Grading and construction equipment would be required to prepare the site and install the dry cooling tower. The additional soil disturbance and equipment activity would result in increased fugitive dust and vehicle exhaust emissions. However, these emissions are short-term impacts because they occur only during project construction.

Air impact modeling for construction of the proposed project included calculating project contributions to existing violations of the State 24-hour PM10 standard. The increased construction activity for an air-cooled system would increase the project's contribution to local PM10 levels relative to the proposed project, increasing the short-term and potentially unavoidable construction air impacts. Implementation of staff's proposed construction mitigation would ensure that this contribution would be less than significant.

No additional emissions would be created by the air-cooled system itself, but the operation of the system could change the impact of the PM10 and PM2.5 emissions that are created by the project. As the air is moved over the coils, PM10 and PM2.5 suspended in the ambient air and from the ground surface would be resuspended in the atmosphere. Since these PM emissions would not be "new" emissions, and average emission rates vary significantly and seasonally, evaluating those impacts and mitigating them, if necessary, would be difficult.

The Applicant has argued that power plant performance penalties associated with air-cooled condensers (ACCs), compared to the proposed once-through cooling system, would result in additional air pollutant emissions from required additional fuel firing. The performance penalties include increased heat rates and parasitic loads. However, these potential changes in air emissions are highly speculative in California's competitive electricity market. The proposed project will operate as a merchant plant. The owner is not under contractual obligations to provide the proposed capacity in the immediate region. Furthermore, the project owner could choose to generate the "lost" capacity at another company plant or buy capacity on the open market throughout the western system, rather then generating it at the Potrero project. The displaced capacity could be from an emissionless hydropower or nuclear plant, or from a coal plant in Wyoming. Therefore, the emission changes from power plant performance degradation due to air-cooling cannot be tied to the proposed project.

Air Emissions and Impacts of Hybrid Cooling

Construction of a hybrid cooling system would likely produce both construction equipment exhaust and fugitive dust emissions similar to those associated with constructing the dry cooling option. However, compared to the dry cooling option, there would be additional fugitive dust and construction equipment exhaust impacts due to the construction of a pipeline for bringing cooling water to the site. Air impact modeling for the proposed project's calculated contributions to existing violations to the State 24-hour PM10 standard. The increased construction activity for a hybrid cooling system would increase the project's short-term contribution to local PM10 levels relative to the proposed project, increasing the short-term and potentially unavoidable construction air impacts. With the implementation of the staff proposed construction mitigation, staff believes that this contribution would be less than significant.

During operation of the hybrid cooling alternative, there would be PM emissions from the cooling tower drift. The amount of PM is proportional to the amount of drift and the total dissolved solids (TDS) in the circulating water. For the hybrid cooling system with a circulating water flow rate of 148,000 gallons per minute (gpm) and a drift of 0.0005%, the gpm of drift and lbs/hr of PM10 emissions can be calculated. Using the recirculation water's TDS content of approximately 7,000 ppm (estimated by the Applicant), the PM10 emissions of the hybrid cooling tower are estimated as follows:

$$148{,}000\ gpm \times 0.0005\% = 0.74\ \ gpm\ of\ \ drift$$

$$0.74\ gpm \times 8.34\ {}^{lb}\!/_{gal} \times 7000\ {}^{ppmTDS}\!/_{10E6} \times 60\ {}^{\min}\!/_{hr} = 2.59\ {}^{lb}\!/_{hr}\quad of\ \ PM10\ drift$$

$$\frac{2.59\ {}^{lb}\!/_{hr} \times\ 8760\ {}^{hr}\!/_{yr}}{2000\ {}^{lbs}\!/_{ton}} = 11.34\ {}^{tons}\!/_{year}\quad of\ \ Cooling\ Tower\ PM10$$

The annual PM10 emissions from a hybrid cooling tower can vary with drift eliminator efficiency, make-up water TDS, allowable tower TDS, and size of the wet system. The PM10 emissions from cooling tower drift would be required to be mitigated by emission reduction credits.

As with the ACC system, any potential or actual power plant performance penalties compared to the proposed project will not result in air emissions that must be tied to the project.

Because any PM10 emissions increases at Potrero would be required to be mitigated, impacts would be less than significant with the operation of a hybrid cooling system.

Air Emissions Mitigation

Construction

The implementation of the staff's Conditions of Certification regarding construction emissions would address and mitigate any potential impacts from increases in emissions from the construction of the once-through or alternative cooling system options to a less than significant level.

Operation

Any operational air emissions increases at Potrero would be modeled to define impacts and then mitigated or offset, as appropriate.

Conclusion for Air Quality

Staff believes that the construction of the dry or hybrid cooling systems described above would cause a potential short-term and unavoidable PM10 impact to the environment. Staff also believes that staff's proposed Conditions of Certification would minimize emissions, and mitigate the impacts to a less than significant level.

Any potential or actual power plant performance penalties associated with the dry or hybrid cooling systems compared to the proposed project would not result in air emissions that must be tied to the project.

Also, any air emissions increases at Potrero would be modeled for impacts and mitigated or offset, as appropriate. Therefore, there would not be any significant air emissions impacts with the operation of the dry or hybrid cooling systems.

4.2 BIOLOGICAL RESOURCES – AQUATIC

Introduction

The Potrero Power Plant (Potrero PP) is located along the western shore of central San Francisco Bay, the largest estuary on the Pacific coast of the United States. Bay waters in the vicinity of Potrero PP support diverse assemblages of aquatic invertebrates and fishes, as well as resident and migratory water birds and marine mammals. Resources of particular interest in the waters near Potrero PP include Dungeness crab and Pacific herring, species of commercial importance. Pacific herring lay their eggs on hard substrate in the vicinity of Potrero PP. Sensitive fish species that may occur in the vicinity of the Potrero PP include green sturgeon, longfin smelt, Chinook salmon, and steelhead. Invertebrates and forage fish abundant in the waters near Potrero PP, such as Pacific herring and northern anchovy, provide the base of the food web for many higher-level predators including salmonids, sharks and rays, seabirds, and marine mammals.

Aquatic Biological Resources Impacts of Once-Through Cooling

In order to evaluate the impacts of dry and hybrid cooling systems at Potrero, the potential impacts of the proposed project (with once-through cooling) are summarized here for comparison. In contrast to the dry or hybrid cooling alternatives, once-through cooling for Unit 7 could result in several potentially significant impacts to aquatic biological resources. Construction of the new combined intake structure for Unit 7 and Unit 3 would result in a permanent loss of about 0.24 acres of aquatic habitat. About 0.15 acres of the habitat (covering a linear distance of about 200 feet of shoreline) that would be permanently lost is concrete rubble that supports a relatively depauperate rocky intertidal community of barnacles, mussels, rock jingles, shore crabs, and algae. The remaining 0.09 acres that would be lost is shallow subtidal soft bottom habitat that supports a relatively diverse invertebrate assemblage dominated by nematode, oligochaete, and polychaete worms. The water column above these areas provides habitat for many species of fish, including Pacific herring and northern anchovy. Because San Francisco Bay is a unique estuarine ecosystem that supports many sensitive species, permanent loss of Bay habitat is considered a significant adverse impact.

Construction of the new discharge structure of Unit 7, as well as a similar outfall structure for Unit 3, would result in the replacement of natural soft bottom Bay habitat by approximately 3.2 acres of artificial structures. Construction of these submerged structures would not preclude the use of Bay waters by species associated with the water column, and the structures themselves would provide additional habitat for hard bottom species and substrate for the deposition of herring eggs. Construction of the outfalls would result in the replacement of natural Bay bottom with artificial habitat. The construction of numerous piers, jetties, pipes, and other structures has resulted in a substantial cumulative loss of natural Bay soft bottom. Thus, the proposed new outfalls would add to cumulative losses of natural habitat in San Francisco Bay. As mitigation for this fill, the Applicant has discussed with the Port of San Francisco and the Bay Conservation and Development Commission staff the removal of the derelict Wharf 5 in the Pier 70 vicinity. Removal of artificial structures in the Bay would likely provide adequate mitigation for the proposed fill, although the details of this proposed mitigation have not yet been specified.

Entrainment. The once-through cooling system for Unit 7 would circulate up to 227 million gallons per day (mgd) of Bay water through the cooling water system. The use of Bay water for Unit 7 would approximately double the 226 mgd currently permitted for the once-through cooling system of Unit 3. Because the number of larval fishes and planktonic invertebrates sucked through the cooling water system is directly proportional to the volume of water that passes through the system, once-through cooling for Unit 7 would approximately double the losses to entrainment of Unit 3, resulting in the additional loss of many million larval fishes, fish eggs, larval invertebrates, zooplankton, and phytoplankton. These small planktonic organisms form the base of pelagic food chains in the Bay. Because San Francisco Bay is a unique estuarine ecosystem that has been severely impacted by human activities, this loss in productivity would be considered a significant adverse impact. The Applicant has not proposed mitigation for these losses. The Applicant is currently conducting a year-long study to analyze the effects of entrainment by the combined Unit 3 and Unit 7 intake. Fish larvae that would be entrained in the greatest numbers include: unidentified gobies, yellowfin goby, Bay goby, Pacific herring, northern anchovy, and white croaker. Preliminary analysis based on six months of data suggests that entrainment would not result in a decline of any fish or invertebrate species. However, populations of some species fluctuate in San Francisco Bay and there may be years when entrainment effects are greater than indicated in the analysis.

Impingement. Fishes and mobile invertebrates would also be lost by impingement at the combined Unit 3 and Unit 7 intake. The number of organisms impinged is related to several factors, including the volume of water passed through the intake and the design of the intake. The Unit 7 project includes replacement of the existing Unit 3 intake with a new combined Unit 3 and Unit 7 intake. The new intake has several improvements over the existing Unit 3 intake. These improvements are designed to reduce impingement. The approach velocity will not exceed 0.4 feet per second. Many adult fishes can escape impingement at intake velocities below 0.5 feet per second. In addition, the new combined Unit 3 and Unit 7 intake will have a continuously rotating inclined screen design. These screens are expected to reduce the amount of debris buildup in front of the intake, which will reduce the number of organisms trapped in debris and allow more juvenile and adult organisms to avoid impingement (SECAL 200a, AFC page 8.2-13). The Applicant also proposes to reduce impingement losses by implementing a fish return system equipped with a low-pressure spray wash. It is not clear to what extent fishes returned to the Bay with this low-pressure spray wash system will survive. Some may be injured in the process. The organisms with hard exoskeletons such as small shrimps and crabs would be most likely to survive impingement. More fragile organisms such as juvenile fishes likely would not survive impingement. It is not known at this time to what extent these design improvements would offset the greater flow from the additional cooling water for Unit 7. The actual impacts of impingement at the new intake cannot be determined until the new intake is constructed and impingement of aquatic organisms is documented.

Thermal Discharge. The discharge of heated effluent from the once-through cooling system may have adverse impacts on aquatic resources. The existing discharge sometimes results in a temperature elevation at the shoreline that is 10°F above ambient (SECAL 2000b, AFC Supplement Figures 8.2-4 through 8.2-6). Elevated temperatures of the plant’s existing shoreline discharge have been observed to be associated with noticeable changes in the species composition and abundance of intertidal and subtidal algae in the immediate vicinity of the discharge. However, these temperature elevations have been observed to have little effect on invertebrates or the distribution of fishes (SECAL 2000a, AFC pp. 8.2-16). The existing discharge also may have an adverse effect on the development of herring eggs deposited on structures within the area contacted by the discharge plume. Although the Unit 7 project would result in a greater discharge of heated effluent, the new combined Unit 7 and Unit 3 outfalls, which would have long diffuser sections discharging offshore, are expected to reduce the extent of the thermal plume. The thermal plumes from the new outfalls would not contact the shoreline. Therefore, the construction of a once-through cooling system for Unit 7 with new Unit 7 and Unit 3 outfalls may reduce existing thermal impacts. The diversity and abundance of intertidal and subtidal algae near the existing intake would be expected to increase. Potential thermal impacts to herring eggs also would be reduced because the new thermal discharge is not expected to contact the shoreline or the bottom. With the new outfalls, thermal impacts to herring eggs would only occur if the herring laid their eggs on the diffuser nozzles.

Although shoreline impacts would be reduced with the new Unit 3 and Unit 7 outfalls, the thermal discharge would affect habitats farther out in the Bay than the existing discharge. The National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (CDFG) have expressed concern that temperature rises of 4°F or greater may have significant adverse impacts on listed salmonids (J. Dillon, NMFS personal communication 2001; M.Rugg, CDFG, personal communication, 2001). The project area is within Designated Critical Habitat for the Federal Threatened Central California Coast Evolutionarily Significant Unit of steelhead. Steelhead and Chinook salmon do not occur along the shoreline areas currently affected by the Unit 3 discharge. Therefore, moving the outfalls farther offshore would increase the chances that salmonids would come into contact with the thermal plume. Temperature rises exceeding 4°F are expected to be limited to the area immediately above each diffuser port and would not extend along the entire diffuser section. The volume of water with a temperature rise above 4°F would be small and discontinuous. Thus, impacts to listed salmonids of the thermal plumes from the proposed outfalls are unlikely, but cannot be discounted entirely. A steelhead or Chinook salmon could potentially contact the plume and suffer adverse effects, which might include interference with migration or disorientation that could lead to the affected individual becoming the victim of predation.

The existing Unit 3 once-through cooling system would continue to operate as it does presently. Improvements to the Unit 3 system, which would likely reduce existing thermal impacts along the shoreline and may reduce impingement at the intake, would not occur.

The benefits to aquatic resources of replacing the Unit 3 intake would not be likely to offset the impacts of the additional entrainment from the proposed construction of a once-through cooling system for Unit 7, because entrainment would reduce the base of the pelagic food web for organisms throughout the northern portion of South Bay and the southern portion of Central Bay. On the other hand, the reduction in thermal impacts of the Unit 3 intake would affect the small area of shoreline in the immediate vicinity of the existing discharge. It is not known to what extent the new intake will reduce impingement, but impingement at the existing intake is not great. A total of 55,611 fishes and 262,867 invertebrates were impinged during a 1978 to 1979 study (SECAL 2000a, AFC Appendix G page 78).

Aquatic Biological Resources Impacts of Dry Cooling

Dry cooling would not require the construction of any structures in Bay waters and would involve no intake of Bay waters and no discharges to the Bay. Therefore, the dry cooling alternative would have no impacts to the aquatic biological resources of San Francisco Bay. Replacement of the proposed once-through cooling system with a dry cooling system for Unit 7 would eliminate potentially significant impacts of the proposed once-through cooling system to aquatic resources. These significant impacts include substantially increased loss of planktonic organisms by entrainment in the intake and the potential for adverse effects of the thermal discharge to listed salmonids. Fill of San Francisco Bay waters is considered a significant but mitigable impact.

Aquatic Biological Resources Impacts of Hybrid Cooling

Hybrid cooling would not require the construction of any structures in Bay waters and, the design considered would involve no intake of Bay waters and no discharges to the Bay. Therefore, the hybrid cooling alternative, like the dry cooling alternative, would have no impacts to the aquatic biological resources of San Francisco Bay.

As discussed above, implementation of a hybrid cooling alternative for the Unit 7 project would eliminate potentially significant impacts that would occur if the proposed once-through cooling system for Unit 7 were constructed: Bay fill, entrainment, and thermal impacts to listed salmonids. However, benefits to aquatic resources from an improved combined Unit 3 and Unit 7 intake and an improved Unit 3 outfall design compared to the existing Unit 3 system would not occur. These benefits include a reduced area affected by the thermal plume and, possibly, reduced impingement.

Conclusion for Aquatic Biological Resources

Neither the dry cooling alternative or the hybrid cooling alternative would have any direct impacts to aquatic resources.

With either the dry cooling or hybrid cooling alternative, proposed improvements to the Unit 3 cooling water system that are part of the Unit 7 once-through cooling system design would not occur. The proposed improvements to the existing Unit 3 intake and discharge may result in benefits to aquatic resources. The proposed new Unit 3 outfall would reduce the extent of the thermal plume. The proposed design of the new combined Unit 3 and Unit 7 intake may reduce impingement compared to the existing Unit 3 intake, although the increased flows could offset any reductions resulting from the improved design. Because these improvements would benefit a small area of shoreline and impingement on the existing intake is not great, they would not compensate for the loss of productivity from the entrainment of approximately double the number of planktonic organisms.

In conclusion, dry cooling or hybrid cooling for Unit 7 would result in fewer impacts to aquatic resources than a once-through cooling system.

4.3 BIOLOGICAL RESOURCES – TERRESTRIAL

Introduction

Two dry cooling alternatives and one hybrid-cooling alternative are evaluated with respect to the proposed once-through cooling method to determine their relative effects on terrestrial biological resources. Plant communities within one mile of the Potrero site consist primarily of disturbed non-native vegetation and no sensitive species are present. Most of the shoreline in this area has been modified with structures for terminal shipping or stabilized with rock or concrete. Prior to this development, the proposed power plant site and surrounding area was likely dominated by grassland, coastal scrub, and marsh vegetation.

The proposed Potrero Power Plant Unit 7 Project would be an addition to existing generating facilities. Unit 7 would occupy approximately 6.5 acres located in the south-central portion of the 20-acre plant site between the existing substation and power plant facilities. There is no vegetation located at the proposed power plant site and construction laydown area. A small strip of vegetated area approximately 15 feet wide between the Mirant property and the rip-rap along the shoreline has been appropriately described in the Application for Certification (AFC) as disturbed vegetation dominated by non-native species.

In the evaluation of the proposed project (including once-through cooling), four potential impacts were evaluated: (1) loss of sensitive species or their habitats; (2) bird collisions with new stacks; (3) noise effects on terrestrial wildlife; and (4) increases in nitrogen and sulfur deposition rates due to increases in plant emissions. It was concluded that all of these potential impacts of the proposed project to terrestrial biological resources were less than significant. These same impacts are evaluated below for the dry cooling and hybrid cooling alternatives relative to the proposed once-through cooling technology.

Terrestrial Biological Resources Impacts of Dry Cooling

Dry cooling would require the use of additional land (269 feet x 192 feet) for the air-cooled condensers (ACCs), result in additional noise from fans, and result in an increase in air emissions due to the reduction in efficiency. However, there are no sensitive terrestrial species or habitats within the project site or construction laydown area that would be affected by either the additional land requirements or any increase in noise levels. Neither do the dry cooling alternatives alter the evaluation of potential bird collisions with exhaust stacks. It should also be noted that while additional land space would be required within the existing Potrero property, there would be no shoreline disturbance from construction of new cooling water intake/outfall structures if dry cooling were used instead of the proposed once-through cooling technology.

With respect to potential bird collisions, the ACCs are about 108 feet high, far below the heights of 500 to 650 feet that are known to pose a bird collision threat (Goodwin 1975; Maehr et al. 1983; Weir 1974; Zimmerman 1975). Therefore, this alternative would not result in a significant increase in bird collisions.

The potential effects of increased air emissions on increased nitrogen (N) and sulfur (S) deposition rates at sensitive receptors were estimated for the Potrero project with once-through cooling. Under that operating scenario, it was determined that the impacts from the proposed project would be less than significant relative to other sites where the relationship between emissions, N and S deposition, and ecosystem level changes had been studied. The N deposition rate contributed from the Potrero project at San Bruno Mountain (the nearest sensitive receptor) was estimated to be 0.10 kg/ha-y N. This value is far less than the level of 10 to 15 kg/ha-y N deemed significant in Weiss's study (Weiss, 1999) south of the San Francisco area. This study evaluated impacts of N deposition on alteration of habitat suitability for the Bay checkerspot butterfly, a federally listed Endangered species. For dry cooling, the analysis of air emissions indicates that through offsets and/or operational adjustments emissions would be similar to those of the once-through cooling design, and therefore, the effect would still be less than significant. There would be no difference between the two dry cooling alternatives in this respect.

Terrestrial Biological Resources Impacts of Hybrid Cooling

With respect to hybrid cooling, some additional land (491 feet x 50 feet) would be needed relative to once-through cooling for the air-cooled condensers and the reclaimed water supply and return pipelines. The land needed for the condensers would be entirely located within the plant property in an area absent of vegetation. The pipelines would follow existing roads or utility easements that are absent of native vegetation. An underground boring, in addition to that required for the transmission line, would be needed to cross Islais Creek. However, like the transmission line boring, directional boring will enter and exit approximately 180 feet from the channel outside of the vegetated strips along both banks, although the drilling area may extend to 170 feet from the channel. The patches of vegetation that exist among the rip rap along the banks provides some resting area for waterfowl that use the creek; however it is does not contain any sensitive plant or animal species. During construction there will be a disturbance to waterfowl that use this area; however this impact will be temporary and will not affect any threatened or endangered species. Therefore, significant impacts to biological resources from the additional boring, including threatened and endangered species, are not expected to occur. The underground borings at the Creek crossing would not require a streambed alteration permit from the California Department of Fish and Game because the creek is a soft-bottomed channel that has been cut off upstream and is no longer a creek per se, but rather an estuary inlet that is not covered by this permit.

There would also be additional noise (intermediate in level between the proposed once-through and dry cooling alternatives). However, as previously noted for dry cooling, additional noise would not cause impacts to sensitive terrestrial species or their habitats, which are absent from the project area.

With respect to potential bird collisions, the cooling towers for hybrid cooling are about 70 feet high, far below the heights of 500 to 650 feet that are known to pose a bird collision threat (Goodwin 1975; Maehr et al. 1983; Weir 1974; Zimmerman 1975). Therefore, this alternative would not result in a significant increase in bird collisions.

N and S deposition rates for this alternative would potentially be less than those for dry cooling and slightly more than those for once-through cooling, but still less than significant. This alternative introduces a source of salt deposition from cooling tower drift that would ostensibly occur within a narrow radius and not reach sensitive terrestrial receptors at San Bruno Mountain, approximately 4.5 miles southwest of the project site. For hybrid cooling, the analysis of air emissions indicates that through offsets and/or operational adjustments emissions would be less than significant; therefore, no impacts on terrestrial biological resources would occur.

Conclusion for Terrestrial Biological Resources

Relative to the proposed once-through cooling technology, the two cooling options (dry cooling and hybrid cooling) would require more land within the property, and would produce slightly greater noise and slightly more emissions. However, all cooling options (including once-through cooling) would affect terrestrial biological resources similarly, and would not cause significant impacts to terrestrial biological resources.

4.4 CULTURAL RESOURCES

Introduction

Impacts to subsurface cultural resources (prehistoric and historic archaeological sites) could result from construction of facilities necessary for dry cooling or hybrid cooling. Excavation and grading for the foundations of the cooling structures (necessary for both dry cooling and hybrid cooling) and excavation for installation of the water pipeline (for hybrid cooling) could expose and disturb as yet unidentified archaeological material.

Cultural Resources Impacts of Dry Cooling

Potential subsurface cultural resources from the historical period within the power plant property were identified in the cultural resources section of the Staff Assessment. Historical research indicated that gunpowder magazines and an associated dwelling were located somewhere within the power plant property. An archaeological test excavation for a previously proposed power plant expansion project revealed a portion of the foundation of one of the powder magazines within the current power plant property. If the proposed location for the dry cooling facility is on artificial fill placed in the former bay, there is little potential for encountering subsurface cultural resources.

The proposed location of Dry Cooling Alternative One is in the southeastern part of the property near the bay, so it is likely that this location is underlain by fill. However, if the location is not underlain by fill, grading and excavation for construction of the dry cooling facility could encounter cultural resources from the historical period. Such is the situation for the location of Dry Cooling Alternative Two. Dry Cooling Alternative Two may not be underlain by fill and therefore cultural resources could be encountered at that location during grading. If resources were encountered during construction that were determined eligible for the California Register of Historical Resources (CRHR), construction of the dry cooling facility could materially impact cultural resources that are potentially eligible for the CRHR. Mitigation for these potential impacts is presented in the **Cultural Resources** section of this FSA.

Compared to once-through cooling, a somewhat larger area within the power plant property would be subject to construction impacts because of the addition of the dry cooling structure, resulting in a somewhat larger potential to encounter and impact subsurface cultural resources.

Cultural Resources Impacts of Hybrid Cooling

Potential impacts to cultural resources resulting from the hybrid cooling alternative within the power plant property would be similar to the dry cooling alternative, although the hybrid cooling structure would be somewhat smaller than the dry cooling structure, resulting in somewhat less ground disturbance. If the proposed location for the hybrid cooling facility is on artificial fill placed in the former bay, there is little potential for encountering subsurface cultural resources. Given that the proposed location is in the southeastern part of the property near the bay, it is likely that this location is underlain by fill. However, if the location is not underlain by fill, grading and excavation for construction of the hybrid cooling facility could materially impact cultural resources that are potentially eligible for the CRHR. Mitigation for these impacts (such as that proposed in Conditions of Certification for Cultural Resources) would reduce impacts to less than significant levels.

The hybrid cooling alternative requires construction of a water pipeline in city streets between the power plant property and the Southeast Water Pollution Control Center (SWPCP) located approximately one mile southwest of the power plant property near the intersection of Jerrold Avenue and Phelps Street. Construction of the pipeline would require trenching, which has the potential to impact subsurface cultural resources from both the historic and prehistoric periods. Buried resources from the historic period could include buried portions of the Western Pacific Railroad Wharf (located at 25th Street), as well as other as yet unidentified historical resources. Because a portion of the proposed pipeline alignment would cross original land areas (rather than fill placed in former bay/estuary), there is also the potential to encounter subsurface prehistoric cultural resources. The area south of Islais Creek has a high potential for prehistoric cultural resources because Native American settlements were often located where freshwater creeks emptied into the bay. If resources were encountered during construction that were determined eligible for the CRHR, construction of the hybrid cooling facility and the water pipeline could materially impact cultural resources that are potentially eligible for the CRHR.

Compared to once-through cooling, a somewhat larger area within the power plant property would be subject to construction impacts because of the addition of the hybrid cooling structure, resulting in a somewhat larger potential to encounter and impact subsurface cultural resources. However, the most important aspect of the hybrid system is the need to construct a one-mile long water pipeline. Although no subsurface cultural resources have yet been identified along the pipeline route, pipeline construction increases the potential to impact subsurface cultural resources that would not be affected by the proposed project. Conditions to require testing prior to construction would help identify any subsurface resources.

Conclusion for Cultural Resources

The proposed Unit 7 Project and Dry Cooling Alternative One are similar in their potential impact on subsurface cultural resources, although Dry Cooling Alternative One would require somewhat more ground disturbance within the power plant property. The hybrid cooling alternative has significantly greater potential to impact subsurface cultural resources because of the additional ground disturbance necessary to construct the one-mile long water pipeline. Dry Cooling Alternative Two also has greater potential to affect sub-surface cultural resources because it is likely located over an area that is not underlain by fill.

Feasible mitigation measures for all alternatives consist of testing prior to construction to help identify buried subsurface resources, followed by avoidance (if possible) or data recovery of any resources encountered prior to, or during, construction. These mitigation measures would reduce the impacts to cultural resources to less than significant levels. Since it is always preferable to avoid and preserve cultural resources (rather than impact them and mitigate impacts through data recovery), the alternatives that have a lower potential to encounter subsurface cultural resources are preferred.

4.5 HAZARDOUS MATERIALS MANAGEMENT, WORKER SAFETY, AND FIRE PROTECTION

Introduction

As possible alternatives to the once-through cooling system proposed for the Potrero Unit 7 Power Plant, BCDC has requested information regarding impacts of dry and hybrid cooling technologies.

Hazardous Materials Impacts of Dry Cooling

Dry cooling would not use the large volumes of water used in once-through cooling systems, in turn reducing the volume of chemicals (e.g., sodium hypochlorite) needed to control algae growth within the system (particularly in the condenser tubes). Thus, hazardous materials usage would decrease. However, the larger volume of piping (including seals, flanges, and valves) could result in oxygen entry into the system and therefore would require an increased use in oxygen scavengers to prevent corrosion and scaling. The Potrero Unit 7 Project is proposing to use aqueous hydrazine, an acutely toxic hazardous material, as an oxygen scavenger. The increased use of hydrazine for a dry cooling system could be significant. If dry cooling were selected, Conditions of Certification would need to be changed or modified to reflect the types and quantities of these hazardous materials. Staff has already recommended the use of a far safer alternative, carbohydrazide, as an oxygen scavenger. If the Applicant were to select this chemical, or if the Energy Commission requires its use, the overall use of hazardous materials with dry cooling would be the same or less than as with once-through cooling.

Hazardous Materials Impacts of Hybrid Cooling

The hybrid cooling alternative would use larger volumes of water than the dry cooling options, but less than once-through cooling. Therefore, the amount of hazardous materials and the risk of accidental release for hybrid cooling would be somewhat less than with once-through cooling, but somewhat greater than with dry cooling.

Worker Safety and Fire Protection

The risk to workers and the impacts on fire protection would not change significantly with any of the cooling technologies. This is mostly due to the generic nature of worker and fire protection required at a power plant licensed by the CEC.

Conclusion for Hazardous Materials Management, Worker Safety, and Fire Protection

Staff does not consider the impacts from the cooling technologies discussed above to be significantly different, since rather minor differences in hazardous materials use would exist with any of the options. Because both the Applicant and staff have proposed mitigation measures or Conditions of Certification, the overall risk due to hazardous materials is approximately the same for all proposed cooling technologies.

Staff concludes that the impacts to workers and fire protection are also similar with all cooling options.

4.6 LAND USE

Introduction

A project would be considered to have a significant effect on land use if the project would physically divide an established community, or conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project. A project would also have a significant impact on land use if it were to create unmitigated noise, dust, public health hazard or nuisance, traffic, or visual impacts. Because the cooling alternatives do not involve the construction of a physical linear barrier, they are not considered capable of physically dividing the community. Therefore, the following analysis focuses on consistency with applicable land use laws, ordinances, regulations, and standards (LORS), and potential impacts that could cause land use incompatibilities. Because land use compatibility impacts are largely based on other issue areas (noise, visual resources, etc.), the conclusions about potential land use compatibility impacts are derived from conclusions about significant impacts for other issue areas.

Land Use Impacts of Dry Cooling

Dry Cooling Alternative One

In Dry Cooling Alternative One, the dry cooling facilities would be located in the southeastern corner of the Potrero PP site and would appear as a large elevated box-like structure approximately 108 feet high, which would be about the same height as the primary proposed Unit 7 structure that encloses the gas turbines, heat recovery steam generator, and steam turbine complex.

As noted in the **Land Use** section of the FSA, the project site is designated Heavy Industry in the San Francisco General Plan and zoned M-2 (Heavy Industry). According to the CCSF Zoning Administrator, a power plant and appurtenant facilities are permitted in this zone. The dry cooling facilities would require a large amount of space, but can be accommodated on the site without violating the development standards of the M-2 zone (height, setbacks, floor-area ratio, etc.). Therefore, this alternative would be consistent with applicable land use LORS.

Implementation of dry cooling technology would eliminate the need to construct the new Unit 7 intake/discharge cooling system structure in the bay. The proposed Unit 7 intake/discharge structure would require the Applicant to reach an agreement with the Port to construct and maintain the structure on Port lands. Additionally, construction of the intake/discharge structure would be classified as a “bay fill project” by the BCDC, thereby requiring a determination of consistency with relevant BCDC LORS and mitigation for loss of bay habitat. Both of these issues would be eliminated with the implementation of the dry cooling alternative. Consequently, with dry cooling the Applicant would not need to consult with the BCDC regarding bay fill nor with the Port regarding construction and/or operation of the Unit 7 intake/discharge structure.

Land use compatibility is determined by evaluating the effects a project would have on surrounding land uses. Land use incompatibilities can occur if a project's off-site impacts significantly affect neighboring uses in an adverse way. The dry cooling facility would be a major noise source, necessitating implementation of feasible mitigation in the form of a modified fan configuration to ensure that no significant change in ambient noise levels would occur. Due to its size, the dry cooling facility would also be visually prominent from various key observation points, even with mitigation. For these reasons, the dry cooling facility could have potentially significant visual impacts (see the **Noise** and **Visual Resources** sections of this analysis). As a result, this alternative has the potential to result in greater land use incompatibilities than the proposed project.

As described in the **Noise** section of this analysis, while the potential noise impacts of the dry cooling facility can be substantially reduced with feasible mitigation (modified fan configuration), the increase in ambient noise levels at the property line would exceed the level that staff uses as a threshold for significance. However, there are no adjacent sensitive receptors that would be exposed to these elevated ambient noise levels. As a result, no significant noise impacts are expected and no land use incompatibilities would occur due to elevated noise levels. As described in the **Visual Resources** section of this analysis, the facility's visual impacts would remain significant even with mitigation (Potential mitigation for visual impacts include landscaping; surface treatment of structures (color, texture, and limited design) to minimize visual intrusion, and contrast, and limitations on lighting.). Therefore, the implementation of Dry Cooling Alternative One would result in a potentially significant land use compatibility impact based on significant adverse effects related to visual resources. No other significant off-site effects capable of producing land use incompatibilities have been identified.

In conclusion, the only significant land use impact associated with this alternative would be potential land use incompatibilities based on significant visual impacts.

Dry Cooling Alternative Two

The land use impacts of Dry Cooling Alternative Two would be similar to those described above for Dry Cooling Alternative One. The two alternatives are very similar except that with Dry Cooling Alternative Two, the cooling facilities would be located in the northwestern corner of the Potrero PP site, whereas with Dry Cooling Alternative One they would be located in the southeastern corner of the site. Use of dry cooling at Dry Cooling Alternative Two, would be consistent with applicable land use LORS (see discussion above for Dry Cooling Alternative One).

Implementation of dry cooling technology would eliminate the need to construct the new Unit 7 intake/discharge structure in the bay, in turn eliminating the need to consult with BCDC and the Port on this issue.

As described above for Dry Cooling Alternative One, the dry cooling facility would be a major noise source and would result in the construction of a visually prominent structure on the site. The location of Dry Cooling Alternative Two would significantly increase noise levels at properties west of the power plant site and substantial mitigation (in the form of re-designed fan configuration) would be required to reduce noise levels (see the **Noise** section of this analysis). With implementation of this mitigation, significant off-site noise impacts can be avoided. Therefore, no land use incompatibilities based on noise are expected. However, because the dry cooling facility would be a large and visually prominent structure, it would have a significant adverse impact on views from various key observation points (see the **Visual Resources** section of this analysis). The impacts on visual resources would remain significant even with mitigation. Thus, implementation of Dry Cooling Alternative Two would result in a significant land use compatibility impact based on significant adverse effects on visual resources. No other significant off-site effects capable of producing land use incompatibilities have been identified.

In conclusion, the only significant land use impact associated with this alternative would be potential land use incompatibilities based on significant visual impacts.

Land Use Impacts of Hybrid Cooling

The hybrid cooling facilities would appear as a linear, box-like structure approximately 70 feet high, located west of the Unit 3 stack, adjacent to 23rd Street. This would be shorter than the primary proposed Unit 7 structure that encloses the gas turbines, heat recovery steam generator, and steam turbine complex. The hybrid cooling alternative would require the construction of a pipeline to bring cooling water to the site from the San Francisco Southeast Water Treatment Center, located approximately one mile southwest of the Potrero PP site.

As described in the **Land Use** section of the FSA, the Potrero PP site is located in an area zoned Heavy Industry (M-2). The power plant and appurtenant cooling facilities are permitted in this zone. The hybrid cooling facilities can be accommodated on the site without violating the development standards of the M-2 zone (height, setbacks, floor-area ratio, etc.). Therefore, this alternative would be consistent with applicable land use LORS.

Similar to the dry cooling alternatives, implementation of hybrid cooling technology would eliminate the need to construct the new Unit 7 intake/discharge cooling system structure. Consequently, the Applicant would not need to consult with the BCDC regarding bay fill nor with the Port regarding construction and/or operation of the Unit 7 intake/discharge structure. This is the same as with the two dry cooling alternatives addressed above.

The hybrid cooling facility would be a major noise source and, consequently, off-site noise impacts are possible. With mitigation (modified fan configuration), significant off-site noise impacts can be avoided (see the **Noise** section of this analysis). According to the **Visual Resources** analysis, the hybrid cooling facility would not result in any significant effects on views. No other significant off-site effects capable of producing land use incompatibilities have been identified. Therefore, no significant land use incompatibilities are expected to result from implementation of the Hybrid Cooling alternative.

In conclusion, the implementation of the hybrid cooling technology would not result in any new significant land use impacts. Therefore, no mitigation would be required.

Conclusion for Land Use

From a land use perspective, the primary difference among the cooling technologies is their potential to result in land use incompatibilities. As indicated in the preceding evaluation, both of the dry cooling alternatives could result in significant land use compatibility impacts based on significant impacts to visual resources. The hybrid cooling alternative would not result in any new significant land use impacts.

All of the cooling alternatives discussed above would comply with applicable land use LORS. Similarly, the proposed project (utilizing once-through cooling with bay water) would also comply with applicable land use LORS.

An advantage shared by all of the cooling alternatives discussed above compared to the proposed project is the elimination of the need to construct a new intake/discharge cooling system structure in the bay. However, in staff's opinion, use of these cooling alternatives would not eliminate the need to comply with Conditions of Certification **LAND-3**, **LAND-4**, and **LAND-5** regarding public shoreline access and Bay Trail improvements.

In conclusion, the proposed project and the hybrid cooling alternative are superior to the dry cooling alternatives due to avoidance of land use incompatibility impacts stemming from significant impacts to visual resources. However, from a land use perspective, the proposed project and the hybrid cooling alternative are not substantially different from each other. Both would be consistent with applicable land use LORS and neither would be expected to result in any significant land use incompatibilities. Therefore, neither the proposed project nor the hybrid cooling alternative would have a substantial advantage over the other, but both are more favorable than the dry cooling alternatives from a land use perspective because of the avoidance of potential land use incompatibilities.

4.7 NOISE

Introduction

The use of either a dry or hybrid cooling system would introduce new noise sources to the proposed plant design. These noise sources consist of fans, motors, gearboxes, and, in the hybrid system, cascading water. The most significant noise sources would be the fans, which would be located relatively high on the system structures, although the hybrid system fans may be lower than the dry cooling system fans. Motors and gearboxes are typically located near ground level, and may be shielded by other components of the system. The sides of the cooling tower structure may significantly shield noise produced by cascading water.

The array of structures for both types of cooling systems may provide shielding of some units for receptors, depending on the receptor position. That is, one of the cooling towers or radiator units may block line of sight to some or all of the others, which would reduce the noise received from the shielded units. For receptors parallel to the array, each unit would contribute noise to the total noise exposure, with little or no shielding.

Any type of combined cycle power plant would introduce the possibility of high start-up noise levels due to the need to bypass HRSG-produced high-pressure steam to the condenser until it is of adequate quantity and quality to send to the steam turbine. For dry cooling systems, the high-pressure start-up steam would be ducted into the manifolds leading to the air-cooled condensers (ACCs). Silencers or other acoustical treatment may be required in the steam lines to ensure that noise due to this steam bypass does not exceed acceptable levels.

Noise level data used for this analysis were obtained for a baseline case and two options from GEA, a supplier of cooling equipment for power plants and similar industrial installations. The actual noise emissions of a given cooling system installation may vary from these values, depending upon final system configuration, but the values presented here are expected to be reasonably representative of typical installations.

Noise Impacts of Dry Cooling

Dry Cooling Alternative One

In Dry Cooling Alternative One, the array of ACCs would be placed on the southeast portion of the project site. Thirty-five fan units are proposed. Two noise-reducing options were provided by GEA, which may be considered as potential noise mitigation measures. The reference noise levels and operational assumptions are presented in Table 3. The "Baseline Case" in **POTRERO UNIT 7 COOLING OPTIONS Table 3** is the configuration conceived of in Dry Cooling Alternatives One and Two (defined in Chapter 3). Options 2 and 3 are different fan configurations that would allow quieter operation.

POTRERO UNIT 7 COOLING OPTIONS Table 3
Cooling Fan Installation Operational Assumptions: Dry Cooling Alternatives

Option	No. of Fans	Motor Ratings	Sound Level, dBA at 400 feet	Layout
1 (Baseline Case)	35	200 HP	65	269' x 192'
2	40	150 HP	59	300' x 188'
3	45	100 HP	51	338' x 188'

Given the design assumptions listed above, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted noise levels at the nearest affected receptors are given by **POTRERO UNIT 7 COOLING OPTIONS Table 4**.

POTRERO UNIT 7 COOLING OPTIONS Table 4
Predicted Cooling Fan Noise Levels: Dry Cooling Alternative One

Receptor	Distance, feet	Sound Level, dBA			
		Option 1 (Baseline Case)	Option 2	Option 3	Ambient
Nearest Property Line	30	87	81	73	54-62
Nearest Residences	1,700	52	46	38	47-51

The predicted values indicate that in the Baseline Case (Option 1), the fan noise levels would exceed the noise standards of the San Francisco Noise Ordinance[1] at the nearest property line as well as at the nearest residences. The fan noise levels at both locations would also exceed the 5 dBA L_{90} [2] increase, which staff uses as a threshold to determine whether project noise would result in a significant noise impact.

Noise mitigation would be required to achieve compliance with the LORS, and to ensure that no significant change in ambient noise levels would occur. Design Option 3 would have to be implemented as mitigation to achieve these objectives. Even in this case, the change in ambient noise levels at the property line would exceed the 5 dBA L_{90} increase that staff uses as a threshold to determine whether project noise would result in a significant noise impact. However, there are no sensitive receivers at the property line, so no significant noise impacts would be expected.

Dry Cooling Alternative Two

Dry Cooling Alternative Two would place the ACC units approximately 900 feet west of the location proposed for Dry Cooling Alternative One. The relocation alone would significantly increase noise levels at the properties west of the power plant site. In addition, no shielding would be provided by the power plant itself, because the ACCs would be located near Illinois Street. As a result, this alternative would be expected to require substantially more extensive noise mitigation to achieve the City of San Francisco noise standards than would Dry Cooling Alternative One.

The noise levels assumed for Dry Cooling Alternative Two are the same as given by **POTRERO UNIT 7 COOLING OPTIONS Table 3**.
Given the assumptions detailed below, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted

[1] The City and County of San Francisco's Noise Ordinance presents a basic noise level criteria for most residential land uses (zoned R-1-D, R-1 and R-2) are that the average noise level caused by the source shall not exceed 50 dBA at nighttime (10 p.m. to 7 a.m.), or 55 dBA in daytime (7 a.m. to 10 p.m.), measured at the affected property line. The noise standards for industrial-zoned land are 70 dBA (M-1) and 75 dBA (M-2), any time. In the absence of specific noise standards, Section 2901.11 states that producing a noise level that exceeds the ambient noise level by 5 dBA or more when measured at the receiving property line is a violation of the Code.

[2] L_{90} is the background noise level that is exceeded 90% of the time.

noise levels at the nearest affected receptors are given by **POTRERO UNIT 7 COOLING OPTIONS Table 5**.

POTRERO UNIT 7 COOLING OPTIONS Table 5
Predicted Cooling Fan Noise Levels: Dry Cooling Alternative Two

Receptor	Distance, feet	Sound Level, dBA			
		Option 1 (Baseline Case)	Option 2	Option 3	Ambient
Nearest Property Line	30	87	81	73	54-62
Nearest Residences	1,200	55	49	41	47-51

The predicted values indicate that, in the Baseline Case (Option 1), the fan noise levels would exceed the noise standards of the San Francisco Noise Ordinance at the nearest property line as well as at the nearest residences. The fan noise levels at both locations would also exceed the 5 dBA L_{90} increase, which staff uses as a threshold to determine whether project noise would result in a significant noise impact.

For Dry Cooling Alternative Two, noise mitigation in the form of a different fan design (see Table 3) would be required to achieve compliance with the LORS, and to ensure that no significant change in ambient noise levels would occur. Design Option 3 would be required to achieve these objectives, except that the change in ambient noise levels at the property line would exceed the 5 dBA L_{90} increase, which staff uses as a threshold to determine whether project noise would result in a significant noise impact. However, there are no sensitive receivers at the property line, so no significant noise impacts would be expected.

Noise Mitigation for Dry Cooling

Additional noise reduction could be possible with the use of barriers or “super-low noise fans.” The super-low noise fans are reported to be substantially more efficient than low noise or conventional (propeller-type) fans, so that less additional energy is required. Super-low noise fans may reduce fan noise by up to 20 dBA.

Noise due to motors and gearboxes can be significantly reduced by enclosing or lagging the units. These measures are expected to be feasible.

The Applicant has stated that noise mitigation to achieve compliance with the City of San Francisco noise standard of 75 dBA at the property line could also be achieved by building noise barriers integral with the cooling tower arrays.

The predicted noise levels associated with the unmitigated dry cooling alternatives are significant in terms of both the LORS and the change in noise levels relative to the ambient noise environment. Mitigation measures for the nearest sensitive receptors are expected to be feasible for either of the dry cooling alternatives.

Noise Impacts of Hybrid Cooling

Operational Noise Impacts

The array of cooling towers for the hybrid cooling system would be placed on the southeast portion of the project site. Ten cooling units are proposed. Staff developed working assumptions for this alternative using the data provided by GEA, adjusting for the use of 10 fans instead of 35. Similarly, staff estimated the effects of noise-reducing options to be the same as expected for the dry cooling alternatives. The reference noise levels and operational assumptions are presented in **POTRERO UNIT 7 COOLING OPTIONS Table 6**.

POTRERO UNIT 7 COOLING OPTIONS Table 6
Cooling Fan Installation Operational Assumptions: Hybrid Cooling Alternatives

Option	No. of Fans	Motor Ratings	Sound Level, dBA at 400 feet	Layout
1 (Base Case)	10	200 HP	62	N/A
2	12	150 HP	56	N/A
3	13	100 HP	48	N/A

Given the assumptions listed above, the noise levels due to the fan installations at the nearest receptors were predicted, based upon hemispherical spreading. The predicted noise levels at the nearest affected receptors are given by **POTRERO UNIT 7 COOLING OPTIONS Table 7**.

POTRERO UNIT 7 COOLING OPTIONS Table 7
Predicted Cooling Fan Noise Levels: Hybrid Cooling Alternative One

Receptor	Distance, feet	Sound Level, dBA			
		Option 1 (Baseline Case)	Option 2	Option 3	Ambient
Nearest Property Line	30	84	78	70	54-62
Nearest Residences	1,700	49	43	35	47-51

The predicted values indicate that, in the Baseline Case (Option 1), the fan noise levels would exceed the noise standards of the San Francisco Noise Ordinance at the nearest property line as well as at the nearest residences. The fan noise levels at both locations would also exceed the 5 dBA L_{90} increase that staff uses as a threshold to determine whether project noise would result in a significant noise impact.

Noise mitigation in the form of modified fan design would be required to achieve compliance with the LORS, and to ensure that no significant change in ambient noise levels would occur. Design Option 3 would be required to achieve these objectives. The change in ambient noise levels at the property line would still exceed the 5 dBA L_{90} increase that staff uses as a threshold to determine whether project noise would result in a significant noise impact. However, there are no sensitive receivers at the property line, so no significant noise impacts would be expected.

Noise Mitigation for Hybrid Cooling

It is possible that additional noise reduction could be realized by the use of barriers or "super-low noise fans." The super-low noise fans are reported to be substantially more efficient than low noise or conventional (propeller-type) fans, so that less additional energy is required. Super-low noise fans may reduce fan noise by up to 20 dBA.

Noise due to motors and gearboxes can be significantly reduced by enclosing or lagging the units. These measures are expected to be feasible.

Noise due to cascading water, though usually not significant due to its low noise level as compared to the noise produced by fans and other mechanical equipment, can also be reduced by ensuring that the water hits a sloped surface at the bottom of the tower.

The Applicant has stated that noise mitigation to achieve compliance with the City of San Francisco noise standard of 75 dBA at the property line could also be achieved by building noise barriers integral with the cooling tower arrays.

Construction Noise Impacts

Since it would be necessary to bring cooling water to the site through a new pipeline, the hybrid cooling alternative would also have the potential for construction noise impacts. The new water line would connect to the San Francisco Southeast Water Treatment Center, about one mile southwest of the power plant site. The pipeline would be constructed within city streets, which would introduce typical construction noise sources to the receptors along the route. The noise sources could include pavement breakers, compressors, and diesel-powered mobile equipment. The City of San Francisco Municipal Code would regulate noise levels and hours of operation of construction equipment.

Conclusion for Noise

Of the three cooling options, the proposed once-through system would have the fewest potential noise impacts, as the only significant noise sources would be pumps and motors, which are relatively quiet as compared to the remainder of the equipment comprising the power plant.

The dry cooling option would produce the highest unabated noise levels, as there would be more fans than in the hybrid cooling system, and the baseline noise levels of the fans are higher than in the hybrid cooling system. Dry Cooling Alternative Two would place the fans substantially closer to potentially affected properties, and would require correspondingly greater noise mitigation than Dry Cooling Alternative One. Mitigation measures that would reduce these impacts to less than significant levels appear to be feasible for both dry cooling alternatives.

The wet/dry cooling option would produce significantly higher unabated noise levels than the once-through system, but the noise levels would be lower than for the dry cooling system. Mitigation measures appear to be feasible for the wet/dry cooling alternative.

4.8 PUBLIC HEALTH

Introduction

This section evaluates the health risks from operating the Potrero Unit 7 Project using dry and hybrid cooling technologies, and compares such risks with the cooling-related baseline risk from Unit 3, as currently operated using once-through cooling. The potential impacts addressed in this section are the cancer and non-cancer impacts from exposure to the project's non-criteria pollutants (or air toxics) for which there are no specific air quality standards. Such risks result mostly from inhalation exposure. The pollutants of concern in this regard are those from the project's combustion turbines, cooling structures, or equipment to be used for construction. The methods for assessing the cancer and non-cancer health impacts of such pollutants are presented in the FSA. Since staff considers the risk of cancer as the most sensitive measure of the potential for health hazards from specific sources of environmental pollutants, the relative impacts of these cooling technologies are assessed in terms of their respective cancer risk levels. The potential impacts of the companion criteria pollutants (for which there are specific air quality standards) are addressed in the **Air Quality** section, in terms of compliance with the applicable standards.

The air toxics of concern in this analysis would result from both construction and operation. Construction emissions include diesel exhaust and dust-related PM10 on which there are adsorbed air toxics. Pollutants from operations include combustion by-products and air toxics from cooling tower drift.

Health Impacts of Once-Through Facility Cooling

Since once-through cooling system is operated as a closed system, it does not allow for human inhalation exposures to the potentially toxic additives usually added to the utilized water to prevent bio-fouling and system corrosion. Therefore, once-through cooling should not be seen as posing a significant health risk from the existing Unit 3 operations.

Health Impacts of Dry Cooling

As noted in the **Air Quality** section, the additional construction activities from erecting a dry cooling structure would increase the dust-related PM10 emission whose impacts of concern in this analysis would result from the interaction of the toxic pollutants that might be adsorbed onto it. Such adsorption would be associated with specific soil contamination that must be mitigated before beginning construction. The requirements for ensuring such pre-construction mitigation are specified in the **Waste Management** section of the FSA and should be adequate for the proposed Unit 7 or any cooling alternatives that might be used.

The toxic health risks from all diesel equipment emissions would be minimized through implementation of the Conditions of Certification in the **Air Quality** section, which would also apply to construction of any cooling structures that might be used for the project.

The only other dry cooling-related toxic impacts of potential significance would be the emission increases from increased generation that might be considered necessary to counteract the loss in generation efficiency. Since such loss can easily be replaced at other generating facilities without increased power generation, staff does not consider the potential loss in efficiency as a significant factor in the assessment of health risks related to dry cooling. This means that dry cooling would be incapable of significantly increasing the 0.658 in a million cancer risk specified in the FSA for the proposed Unit 7 project. Staff regards this suggested cancer risk as less than significant.

Health Impacts of Hybrid Cooling

Construction of a hybrid cooling system would generate the same diesel and dust emissions associated with construction of the dry cooling system. As with dry cooling, implementation of staff's proposed mitigation requirements would be adequate to reduce the cancer and non-cancer risks of concern. The implementation of Conditions of Certification is specified in the **Air Quality** and **Waste Management** sections of the FSA.

The other hybrid cooling-related impacts of potential concern would result from exposure to any toxic water constituents that would be emitted in the wet cooling phase. Such constituent emissions do not occur with once-through cooling. Health impacts from such emissions would mainly depend on the quality of the utilized water. For any such application, using water that has been purified to maintain its toxic constituents below applicable drinking water standards would prevent the health impacts of concern. Staff typically finds the risk from conventional cooling towers to be at less than significant levels. If reclaimed water from Southeast Water Treatment Plant were to be utilized for this project, tertiary treatment would be required to maintain these pollutants at the desired levels. Using an effective drift eliminating system would minimize the potentially impacted area. An efficiency of 0.0005% is presently achievable for such systems. Staff considers such hybrid cooling-related water use as incapable of adding significantly to the 0.658 in a million cancer risk calculated for Unit 7 as currently proposed with once-through cooling.

Conclusion for Public Health

Since the proposed once-through cooling system is a closed system that does not expose plant workers or area residents to any constituents of the utilized Bay water, its continued use in the proposed Unit 7 would not introduce any cooling-related health risk to the project area. The use of dry cooling would also prevent exposure to these water constituents, thereby avoiding a significant health risk from facility cooling. The use of hybrid cooling could theoretically introduce a cooling-related risk to the area. However, the requirements for water purification would be adequate to reduce any such health risks to less than significant levels. Compliance with staff's recommended mitigation measures would be adequate to reduce all construction-related air toxics emissions to less than significant levels. Staff concludes from these findings that the dry and hybrid cooling alternatives could each be built and operated in ways that would pose a less than significant public health risk.

4.9 SOCIOECONOMIC RESOURCES

Introduction

Construction of a new power plant could have either adverse or beneficial socioeconomic impacts because the new facility would change the needs for water, land, or public services, require a large temporary construction force, and generate revenues to public agencies. Dry or hybrid cooling alternatives, having potential impacts on noise, land use, and visual conditions, could have impacts on public finance or surrounding neighborhoods that are different from the proposed use of once-through cooling.

Socioeconomic Impacts of Dry Cooling

Dry cooling would not have significant impacts on employment or housing demand, and thus not on schools either. As with other cooling technologies, direct fiscal impacts to San Francisco should be positive because of higher property taxes generated by the new plant. Potential unmitigated visual impacts, resulting from the presence or operation of large dry cooling equipment on the Potrero site, could generate greater community concern about land use compatibility than once-through cooling. This impact of dry cooling could have adverse neighborhood consequences compared to once-through cooling, which could potentially affect the sense of neighborhood and property values. This would be true for both dry cooling alternatives. Potentially significant noise impacts can be reduced with revised fan configurations, but the visual impacts of the air-cooled condensers are considered to be significant and unmitigable for both dry cooling sites (see **Noise** and **Visual Resources** analysis in this study). These impacts also raise environmental justice concerns in the community.

Socioeconomic Impacts of Hybrid Cooling

Hybrid cooling would not have significant impacts on employment or housing demand, and thus not on schools either. As with other cooling technologies, direct fiscal impacts to San Francisco should be positive because of higher property taxes generated by the new plant. Community impacts of hybrid cooling would be similar to those of once-through cooling, and should not be significant from a socioeconomic perspective.

Construction of a pipeline connection to the San Francisco Southeast Water Treatment Center (for the cooling water supply for the hybrid cooling facility) would require construction impacts on city streets. Through coordination with other agencies and public information as proposed in Condition of Certification **SOCIO-3** (but extended to cover the longer disruption of public right-of-way), the construction impacts on city streets could be reduced to less than significant levels. Payment to the City and County of San Francisco for treated water would provide slightly greater fiscal benefits than once-through cooling.

Conclusion for Socioeconomics

Significant neighborhood impacts could be generated if visual or land use impacts of dry cooling cannot be mitigated on the Potrero site. As described in the **Visual Resources** section, the size of proposed structures for the dry cooling alternative would alter community perception and compatibility compared to the once-through cooling alternative. With the exception of these impacts, the socioeconomic impacts are not considered to be substantial or significant for any of the cooling technologies analyzed. The employment and fiscal benefits to the community would remain positive.

4.10 TRAFFIC AND TRANSPORTATION

Introduction

The development of a dry cooling system for the Potrero Unit 7 would increase truck traffic for the delivery of structural steel and other materials and supplies. This would be offset by the reduction of truck deliveries of materials and supplies for the construction of the once-through cooling system including the circulating water intake and discharge structures.

The truck traffic associated with the construction of either a dry or hybrid cooling system would be for the delivery of material, equipment, and supplies that would occur over a six to eight week period. This traffic would result in an increase of two to four truck deliveries per day.

The peak workforce is not expected to increase if the Applicant chooses to opt for dry or hybrid cooling.

Traffic and Transportation Impacts of Dry Cooling

The truck traffic associated with the construction activities for dry cooling should not result in a significant impact on traffic as long as the Applicant follows the mitigation measures and Conditions of Certification set forth in the **Traffic and Transportation** section of the FSA.

Traffic and Transportation Impacts of Hybrid Cooling

The hybrid cooling system would require installation of water pipelines within city streets. Construction impacts on traffic and the truck traffic associated with the hybrid cooling towers should not result in a significant impact on traffic as long as the Applicant follows the mitigation measures and Conditions of Certification set forth in the **Traffic and Transportation** section of the FSA.

Conclusion

The type of cooling system used for Potrero Unit 7 will not have a significant impact on traffic.

4.11 VISUAL RESOURCES

Introduction

This section presents a visual analysis of the various cooling options compared to a baseline established by the existing Potrero Power Plant (Units 3 through 6). Implementation of any of the cooling alternatives would also include the removal of the existing Station A complex with its prominent, geometric block form.

The primary issue of concern with respect to visual resources is the introduction of additional visible structures and plumes into the power plant and waterfront landscape. Specifically, with the dry cooling option, the air-cooled condenser (ACC) would be visible as a large, elevated, geometric structure that could appear quite massive from foreground viewing distances depending on viewing location. The hybrid cooling tower (plume abated design) would be a narrower and lower though longer structure. Its lower height would reduce its potential visibility. In either case, the cooling structures would exhibit an industrial visual character similar to that of other existing and proposed structures at the site.

The following assessment of visual impacts is based on an analysis conducted from nine representative key observation points (KOPs) (see **Visual Resources** section of the FSA).

Visual Resources Impacts and Mitigation of Dry Cooling

Dry Cooling Alternative One

Under Dry Cooling Alternative One, the proposed power plant facilities including the ACC would be located immediately west of the Unit 3 power building and stack. The ACC would appear as a large elevated box-like structure (269 feet long x 192 feet wide x 108 feet high). Table 8 summarizes Dry Cooling Alternative One's visual impacts by Key Observation Point (KOP). As shown in the table, compared to existing views, an increase in view blockage caused by project structures would be experienced at three of the nine representative viewing areas (KOP 1 – Potrero Hill/Watchman Way, KOP 2 – Potrero Hill/20th and Mississippi, and KOP 3 – I-280/Third Street). The resulting visual impact on these three viewing locations would be significant and unmitigable. From KOPs 4 through 9, the resulting visual impacts would be adverse but not significant given the relatively small degree of visual contrast and view blockage that would be caused and their limited noticeability from these viewing locations.

Even though Dry Cooling Alternative One would eliminate the visual impact associated with the cooling water intake structure, the proposed project is preferred over Dry Cooling Alternative One because the proposed project would result in less view blockage of higher quality landscape features (Bay waters, East Bay Hills, and sky) when viewed from foreground residential areas and would not cause significant, unmitigable visual impacts. Potential mitigation for visual impacts includes landscaping; surface treatment of structures (color, texture, and design) to minimize visual intrusion, and contrast, and limitations on lighting. However, in the case of Dry Cooling Alternative One, mitigation would not reduce impacts to less than significant levels at several viewpoints, as described in **POTRERO UNIT 7 COOLING OPTIONS Table 8**.

POTRERO UNIT 7 COOLING OPTIONS Table 8
Summary of Visual Impacts: Dry Cooling Alternative One
(Not Including Vapor Plume Analysis)

KOP	Location	Description of Impact Before Mitigation
KOP 1	Potrero Hill: Watchman Way Neighborhood	**Adverse and Significant.** The proposed power plant and air-cooled condenser (ACC) would appear co-dominant with the existing structures on and adjacent to the site and would exhibit an industrial character similar to Unit 3. The proposed structures would also block a noticeable portion of Bay waters and East Bay Hills that would otherwise be visible north of the Unit 3 stack and power building. While a portion of this view is presently blocked by the existing Station A building (to be removed as part of the project), there would be a net increase in view blockage of the higher quality landscape features over that presently caused by the existing Station A building and Unit 3 Power Plant.
KOP 2	Potrero Hill: 20th and Mississippi Neighborhood	**Adverse and Significant.** The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site and would exhibit an industrial character similar to Unit 3. The proposed structures would also block a noticeable portion of Bay waters and East Bay Hills that would otherwise be visible north and south of the Unit 3 stack. While a portion of this view is presently blocked by the existing Station A building (to be removed as part of the project), there would be a net increase in view blockage of the higher quality landscape features over that presently caused by the existing Station A building and Unit 3 Power Plant.
KOP 3	I-280 / Third Street Neighborhood	**Adverse and Significant.** The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site and would block a noticeable portion of the East Bay hills between the Unit 3 stack and the Unit 3 power building and north of the Unit 3 power building. Although the ACC would screen from view a portion of the existing Unit 3 power building, this screening of features with similar visual quality would not compensate for the blockage of higher quality landscape features (Bay and East Bay Hills) by the proposed HRSG facilities and ACC.
KOP 4	Hunters Point Neighborhood	**Adverse but Not Significant.** The proposed power plant and ACC would block from view a very small portion of visible Bay waters. However, at this middleground viewing distance, the proposed structures and view blockage would be minimally noticeable within the complex waterfront industrial landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 5	Bernal Heights Neighborhood	**Adverse but Not Significant.** The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site and would block a small portion of Bay waters and East Bay Hills between the Unit 3 stack and the Unit 3 power building and north of the Unit 3 power building. However, the ACC would screen from view a portion of the existing Unit 3 power building. Also, much of the Bay view that would be blocked by the new facilities is presently blocked from view by the Station A complex. At this middleground viewing distance, the visibility of the proposed project structures and slight increase in view blockage would not substantially detract from the quality of the panoramic landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.

KOP	Location	Description of Impact Before Mitigation
KOP 6	Bayview Neighborhood	**Adverse but Not Significant.** The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site and would block a small portion of Bay waters and East Bay Hills between the Unit 3 stack and the Unit 3 power building and north of the Unit 3 power building. However, the ACC would screen from view a portion of the existing Unit 3 power building, and much of the Bay view that would be blocked by the new facilities is presently blocked from view by the Station A complex. Also, at this middleground viewing distance, the visibility of the proposed project structures and slight increase in view blockage would not substantially detract from the quality of the panoramic landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 7	Pacific Bell Park	**Adverse but Not Significant.** The proposed power plant and ACC would block from view a very small portion of Hunters Point visible to the south of the project site. However, at this middleground viewing distance, the proposed structures and the view blockage would be minimally noticeable within the complex waterfront industrial landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 8	Agua Vista Park	**Adverse but Not Significant.** The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site and would block a small portion of sky above the roof-top horizon line west (to the right) of the existing Unit 3 stack. While maintaining maximum views of sky, Bay waters, and hills is important, from the KOP 8 vantagepoint, the slight increase in view blockage would not be particularly noticeable in the waterfront industrial landscape and would not substantially detract from the quality of the existing view. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 9	San Francisco Bay	**Adverse but Not Significant.** The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site, with the ACC being partially screened by the Unit 3 power building. Although a portion of Potrero Hill would be blocked from view, this sightline is already partially blocked by the existing Station A complex. Also, the proposed HRSG structures would block a small portion of sky above Potrero Hill. However, in the viewing context of the existing shoreline industrial landscape, the resulting impact would not detract from the quality of the existing views. Also, implementation of this cooling option would eliminate the need for the prominent and highly visible cooling water intake structure that would be constructed as part of the proposed project. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.

Dry Cooling Alternative Two

Under Dry Cooling Alternative Two, the proposed power plant facilities including the ACC would be located immediately west of the Unit 3 power building and stack. The ACC would be located immediately west of Fuel Oil Storage Tank #4 (to the north of the proposed HRSG structures). The ACC would appear as a large elevated box-like structure, approximately 269 feet long x 192 feet wide x 108 feet high. **POTRERO UNIT 7 COOLING OPTIONS Table 9** summarizes Alternative Two's visual impacts by Key Observation Point (KOP). As shown in the table, compared to existing views, an increase in view blockage caused by project structures would be experienced at three of the nine representative viewing areas (KOP 1 – Potrero Hill/Watchman Way, KOP 2 –

Potrero Hill/20th and Mississippi, and KOP 3 – I-280/Third Street). The resulting visual impact on these three viewing locations would be significant and unmitigable (available mitigation, described above, would not reduce impacts to less than significant levels). From KOPs 4 through 9, the resulting visual impacts would be adverse but not significant given the relatively small degree of visual contrast and view blockage that would be caused and their limited noticeability from these viewing locations.

Even though Dry Cooling Alternative Two would eliminate the visual impact associated with the cooling water intake structure, the proposed project is preferred over Dry Cooling Alternative Two because the proposed project would result in less view blockage of higher quality landscape features (Bay waters, East Bay Hills, and sky) when viewed from foreground residential areas and would not cause significant, unmitigable visual impacts.

POTRERO UNIT 7 COOLING OPTIONS Table 9
Summary of Visual Impacts: Dry Cooling Alternative Two
(Not Including Vapor Plume Analysis)

KOP	Location	Description of Impact Before Mitigation
KOP 1	Potrero Hill: Watchman Way Neighborhood	Adverse and Significant. The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site. While the ACC would screen a portion of Fuel Oil Storage Tank #4, the proposed structures would also block a portion of Bay waters and East Bay Hills visible to the north of the Unit 3 stack and above and to the north of Tank #4. While a portion of this view is presently blocked by the existing Station A building (to be removed as part of the project), there would be a net increase in view blockage of higher quality landscape features over that presently caused by the existing Station A building and Unit 3 power plant.
KOP 2	Potrero Hill: 20th and Mississippi Neighborhood	Adverse and Significant. The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site and would exhibit an industrial character similar to Unit 3. The proposed structures would block from view a noticeable portion of Bay waters and East Bay Hills visible to the north and south of the Unit 3 stack. A portion of the Unit 3 power building and stack would also be screened by the ACC, and a portion of the Bay view south of the Unit 3 stack is presently blocked by the existing Station A building (to be removed as part of the project). However, there would be a net increase in view blockage of the higher quality landscape features over that presently caused by the existing Station A building and Unit 3 Power Plant.
KOP 3	I-280 / Third Street Neighborhood	Adverse and Significant. The proposed power plant and ACC would appear co-dominant with existing structures on and adjacent to the site and would block from view a noticeable portion of the East Bay Hills visible to the north of the Unit 3 plant and above and to the north (left) of Fuel Oil Storage Tank #4. A portion of Tank #4 would be screened by the ACC and much of the Bay waters and East Bay Hills that would be blocked from view by Unit 7 are already blocked by the existing Station A (to be removed as part of the project). However, there would be a net increase in view blockage of the higher quality landscape features over that presently caused by the existing Station A building and Unit 3 power plant.
KOP 4	Hunters Point Neighborhood	Adverse but Not Significant. The proposed power plant and ACC would block from view some waterfront industrial structures to the north of the project site (similar quality landscape features). However, in the context of a complex waterfront industrial landscape, the proposed structures and view blockage would be minimally noticeable at this middleground viewing distance. The resulting visual impacts, though not

KOP	Location	Description of Impact Before Mitigation
		significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 5	Bernal Heights Neighborhood	Adverse but Not Significant. The proposed power plant would appear co-dominant with the existing structures on and adjacent to the site and similar in industrial character to Unit 3. While the power plant HRSG structures would cause a small additional view blockage of East Bay Hills, the ACC would be screened from view by intervening landforms. However, removal of the existing Station A building would open up additional sight lines to Bay waters. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 6	Bayview Neighborhood	Adverse but Not Significant. The proposed power plant and ACC would appear co-dominant with existing structures on and adjacent to the site and would block from view a small portion of Bay waters visible to the north (left) of Unit 3 and above and to the north (left) of Fuel Oil Storage Tank #4. However, a portion of Tank #4 would be screened by the ACC and a portion of the Bay waters that would be blocked from view by the Unit 7 facilities is already blocked by the existing Station A (which would be removed as part of the project). At this middleground viewing distance, and within the context of the waterfront industrial setting, the view blockage resulting from the proposed project would not substantially detract from the quality of the panoramic landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 7	Pacific Bell Park	Adverse but Not Significant. The proposed power plant and ACC would block from view a very small portion of Hunters Point visible to the south of the project site. However, at this middleground viewing distance, the proposed structures and the view blockage would be minimally noticeable within the complex waterfront industrial landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 8	Agua Vista Park	Adverse but Not Significant. The proposed power plant HRSG stacks would be partially visible above the warehouses located along the south side of central basin. The ACC would be screened from view by intervening structures. The slight degree of visual contrast and additional view blockage of sky that would be caused by the upper portions of the HRSG stacks would not be substantially noticeable from this viewing location. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 9	San Francisco Bay	Adverse but Not SIgnificant. The proposed power plant and ACC would appear co-dominant with the existing structures on and adjacent to the site. The ACC would be partially screened by the existing fuel storage tanks. The industrial character of the proposed facilities would appear similar to the existing Unit 3 facilities and would result in a low degree of visual contrast. The proposed structures would also cause a partial blockage of the view to Potrero Hill. However, in the viewing context of the existing shoreline industrial landscape, the resulting impact would not substantially detract from the existing visual quality. Also, implementation of this cooling option would eliminate the need for the prominent and highly visible cooling water intake structure that would be constructed as part of the proposed project. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.

Visual Resources Impacts and Mitigation of Hybrid Cooling

Under the Hybrid Cooling Alternative, the proposed power plant facilities including the hybrid cooling tower (HCT) would be located west of the Unit 3 power building and stack. The HCT would be adjacent to 23rd Street. The HCT would appear as a linear, rectangular-shape structure (491 feet long x 50 feet wide x 70 feet high). **POTRERO UNIT 7 COOLING OPTIONS Table 10** summarizes the visual impacts of the Hybrid Cooling Alternative by Key Observation Point (KOP). As shown in the table, compared to existing views, the proposed project with HCT would cause relatively small degrees of visual contrast and view blockage, which would have limited noticeability from the nine viewing locations. The resulting visual impacts would be adverse but not significant and would be further reduced with effective implementation of the mitigation measures and conditions of certification recommended in the **Visual Resources** FSA Section.

This alternative would utilize reclaimed water from the Southeast Water Pollution Control Center (SWPCP), located approximately one mile southwest of the power plant site. Although additional construction impacts would result from the construction of a pipeline to transport the water to the site, these impacts would be temporary and there would be no lasting visual evidence of the pipeline's presence.

The hybrid cooling alternative is preferred over the proposed project because it would eliminate visual impacts associated with the Unit 7 cooling water intake structure, without causing significant view blockage of higher quality landscape features.

POTRERO UNIT 7 COOLING OPTIONS Table 10
Summary of Visual Impacts: Hybrid Cooling
(Not Including Vapor Plume Analysis)

KOP	Location	Description of Impact Before Mitigation
KOP 1	Potrero Hill: Watchman Way Neighborhood	Adverse but Not Significant. The proposed power plant with hybrid cooling tower (HCT) would appear co-dominant with the existing structures on and adjacent to the site and would exhibit an industrial character similar to Unit 3. The proposed power plant would block a portion of Bay waters and East Bay Hills that would otherwise be visible north (to the left) of the Unit 3 power building and stack. However, a portion of this view is presently blocked by the existing Station A building (to be removed as part of the project). The small portion of Bay waters that would be blocked from view by the HCT is presently blocked from view by the Station A building. Also, with removal of Station A, additional sight lines would be opened up through the site to Bay waters that are presently not visible. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 2	Potrero Hill: 20th and Mississippi Neighborhood	Adverse but Not Significant. The proposed power plant with HCT would appear co-dominant with the existing structures on and adjacent to the site and would exhibit an industrial character similar to Unit 3. The proposed power plant would block a portion of Bay waters and East Bay Hills that would otherwise be visible south (to the right) of the Unit 3 stack. However, much of this view is presently blocked by the existing Station A building (to be removed as part of the project). The small portion of Bay waters that would

KOP	Location	Description of Impact Before Mitigation
		be blocked from view by the HCT is presently blocked from view by the Station A building. Also, with removal of Station A, additional sight lines would be opened up through the site to Bay waters that are presently not visible. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 3	I-280 / Third Street Neighborhood	Adverse but Not Significant. The proposed power plant with HCT would appear co-dominant with the existing structures on and adjacent to the site and would exhibit an industrial character similar to Unit 3. The proposed power plant would block a portion of Bay waters and East Bay Hills that would otherwise be visible north (to the left) of the Unit 3 power plant and stack. However, much of this view is presently blocked by the existing Station A building (to be removed as part of the project). The HCT would be effectively screened from view by the warehouse located to the south of the site. Also, with removal of Station A, additional sight lines would be opened up through the site to Bay waters and the East Bay Hills that are presently not visible. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 4	Hunters Point Neighborhood	Adverse but Not Significant. The proposed power plant and HCT would block from view a very small portion of visible industrial development north of site. However, the HCT would be minimally visible because of the screening provided by the warehouse located to the south of the site. At this middleground viewing distance, the proposed structures and view blockage would be minimally noticeable within the complex waterfront industrial landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 5	Bernal Heights Neighborhood	Adverse but Not Significant. The proposed power plant with HCT would appear co-dominant with the existing structures on and adjacent to the site and would block a small portion of Bay waters and East Bay Hills north of the Unit 3 power building. However, the HCT would be substantially screened by the structures immediately south of the project site. Much of the Bay view that would be blocked by the new facilities is presently blocked from view by the Station A complex. Also, at this middleground viewing distance, the proposed project structures and slight increase in view blockage would not substantially detract from the quality of the panoramic landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 6	Bayview Neighborhood	Adverse but Not Significant. The proposed power plant with HCT would appear co-dominant with the existing structures on and adjacent to the site and would block a portion of Bay waters and East Bay Hills visible to the left of the Unit 3 power building and stack. However, the HCT would be substantially screened by the structures immediately south of the project site. Also, much of the Bay view that would be blocked by the new facilities is presently blocked from view by the Station A complex. At this middleground viewing distance, the proposed project structures and slight increase in view blockage would not substantially detract from the quality of the panoramic landscape. The resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and

KOP	Location	Description of Impact Before Mitigation
		conditions of certification.
KOP 7	Pacific Bell Park	**Adverse but Not Significant**. The proposed power plant with HCT would block a very small portion of Hunters Point visible to the south of the project site. However, the HCT would be minimally visible on the site because of its relatively low height and the screening provided by intervening structures and buildings north of the site. At this middleground viewing distance, the proposed structures and resulting view blockage would be minimally noticeable within the complex waterfront industrial landscape. Also, the resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 8	Agua Vista Park	**Adverse but Not Significant**. The proposed power plant with HCT would appear co-dominant with the existing structures on and adjacent to the site and would block a small portion of sky above the roof-top horizon line west (to the right) of the existing Unit 3 stack. However, the HCT would be completely screened from view by the intervening buildings immediately north of the project site. While maintaining maximum views of sky, Bay waters, and hills is important, from the KOP 8 vantagepoint, the slight increase in view blockage would not be particularly noticeable in the waterfront industrial landscape nor would it substantially detract from the quality of the existing view. Also, the resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.
KOP 9	San Francisco Bay	**Adverse but Not Significant**. The proposed power plant with HCT would appear co-dominant with the existing structures on and adjacent to the site. However, the HCT would be minimally visible because of its relatively low height and the screening provided by the intervening Unit 3 structures. Although a portion of Potrero Hill would be blocked from view, this sightline is already partially blocked by the existing Station A complex. Also, the proposed HRSG structures would block a small portion of sky above Potrero Hill. However, in the viewing context of the existing shoreline industrial landscape, the resulting impact would not detract from the quality of the existing views. Also, implementation of this cooling option would eliminate the need for the prominent and highly visible cooling water intake structure that would be constructed as part of the proposed project. Furthermore, the resulting visual impacts, though not significant, would be further reduced by implementing recommended mitigation measures and conditions of certification.

Conclusion for Visual Resources

The hybrid cooling alternative is preferred over the proposed project and both of the dry cooling alternatives because it would eliminate the visual impacts of the cooling water intake structure associated with the proposed project, without causing the significant view blockage of Bay waters, East Bay hills, or sky as would be the case with the dry cooling alternatives. The proposed project would be preferred over the two dry cooling alternatives because the proposed project would result in less view blockage of higher quality landscape features (Bay waters, East Bay hills, and sky) when viewed from foreground residential areas. The two dry cooling alternatives are least preferred because the visual benefit of eliminating the Unit 7 water intake structure would not sufficiently offset the permanent view blockage of higher quality landscape features caused by the elevated dry cooling structure. Significant visual impacts would result from installation of either dry cooling alternative, but not from hybrid cooling.

4.12 WASTE MANAGEMENT

Introduction

This section evaluates the waste management impacts of dry cooling and hybrid cooling technologies for the Potrero Unit 7 project. The technical area of waste management encompasses both hazardous and non-hazardous wastes that are generated during facility construction and operation. Construction wastes include those associated with site preparation, such as contaminated soil from excavating activities, in addition to those generated during actual facility construction. Once-through cooling does not generate any wastes during operation.

Waste Management Impacts of Dry Cooling

Wastes generated during construction of the air-cooled condenser (ACC) at either location (Dry Cooling Alternatives One or Two) would consist of relatively minor amounts of hazardous and non-hazardous wastes such as: excess paint, packing materials, concrete, lumber, spent solvent, and clean-up materials. The amount of soil that would need to be excavated would depend on the final design chosen, but may not be significant if the ACC were built on pilings. Classification of the excavated material would take place after it is stockpiled. It would then be sampled and analyzed to determine on-site reuse or off-site disposal options in accordance with the final Site Mitigation and Implementation Plan. The potential location for Dry Cooling Alternative Two (on land owned by PG&E) was not part of the Environmental Site Assessment, so no conclusions can be drawn regarding the potential for contaminated soil to be present at that site. Operation of either dry cooling location would not generate any wastes during operation. Installation of the dry cooling system would eliminate the dredging of 4,050 cubic yards of sediment that would be associated with the new water intake structures.

Waste Management Impacts of Hybrid Cooling

Construction of a hybrid cooling system would generate wastes similar to those from the other cooling technologies. The amount of soil from excavation activities could be larger, since pilings would not likely be used. Instead, a basin would be constructed that would be placed on the ground, with some excavation required. There could be minor amounts of additional waste generated from construction of a pipeline used to bring cooling water to the Potrero site from the San Francisco Southeast Water Treatment Plant, located about one mile to the south.

During operation of the hybrid cooling system, relatively minor amounts of sludge collect in the basin of the cooling tower and would require removal every few years. The sludge would require testing to determine its classification as hazardous or non-hazardous.

Conclusion for Waste Management

Staff does not consider the waste management impacts from the dry or hybrid cooling technologies to be significantly different from those of once-through cooling, since rather minor amounts of wastes would be generated from any of the technologies. Once-through and dry cooling do not generate any operational wastes, and hybrid cooling generates only a small amount from operation. The types of construction wastes generated would be similar for all three cooling options, with perhaps the least amount of excavation required for dry cooling, because it would be placed on pilings.

4.13 SOIL AND WATER RESOURCES

Introduction

This section analyzes potential impacts on soil and water resources from the construction and operation of dry and hybrid cooling. The analysis focuses on the potential for induced erosion and sedimentation and any adverse impacts to water quality and quantity stemming from the cooling options.

Soil and Water Resources Impacts of Dry Cooling

Earthmoving activities associated with dry cooling would primarily be limited to the construction of the structure. Accelerated wind- and water-induced erosion may result from such earthmoving activities, possibly resulting in increased sediment load within the San Francisco Bay. The dry cooling earthmoving activity would be included as part of the Unit 7 National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharge from construction activities. As required within the permit, the Applicant must develop a Stormwater Pollution Prevention Plan (SWPPP) that identifies Best Management Practices (BMPs) used to properly manage the quantity and quality of stormwater with regard to erosion and sedimentation. Examples of BMPs are the use of sediment barriers, limiting the amount of exposed areas, and construction of conveyance channels, sediment traps, and stormwater control devices. The BMPs would serve as mitigation by minimizing erosion and sedimentation; therefore, impacts related to erosion and sedimentation would be less than significant.

Project excavation may encounter potentially contaminated soils and/or groundwater. The Applicant prepared a Site Mitigation and Implementation Plan (SECAL 2000a, Appendix D) that discusses options as to the handling of the contaminated soils. Refer to the **Soil and Water Resources** and **Waste Management** sections of the FSA for discussions on contaminated soils and groundwater that specify appropriate mitigation measures and Conditions of Certification to ensure less than significant impacts.

Construction and operation of the dry cooling system would not require dredging or disturbance of contaminated Bay sediments. Therefore, this technology would comply with the McAteer-Petris Act.

Soil and Water Resources Impacts of Hybrid Cooling

The hybrid cooling system would require construction of a 10-celled cooling tower and pair of water pipelines. The cooling tower, which would encompass approximately 0.5 acre, would be constructed along the southern portion of the site, between the Unit 3 and Unit 7 power blocks. The source of cooling water for the Unit 7 project would be from the Southeast Water Pollution Control Plant (WPCP), requiring installation of 16-inch and 8-inch water pipelines. The water pipelines, which would extend approximately one mile, would be installed within San Francisco street corridors and under Islais Creek.

Earthmoving for the cooling towers and pipelines would impact approximately 2 acres. Because a SWPPP would be developed, impacts related to erosion and sediment control and stormwater runoff would be reduced to less than significant levels through implementation of BMPs (refer to the dry cooling impact analysis above for a general discussion of BMPs). Boring under Islais Creek could cause drilling fluids to be released in the creek, and potentially deposit contaminated sediments on the channel bottom. However, impacts would be reduced to less than significant levels with implementation of a Frac-Out Contingency Plan.

Excavation activities could disturb potentially contaminated soils and/or groundwater; therefore, proper handling and disposal procedures may be necessary. Refer to the **Soil and Water Resources** and **Waste Management** sections of the FSA for discussions on contaminated soils and groundwater, and appropriate mitigation measures and Conditions of Certification to ensure less than significant impacts.

Because the hybrid cooling alternative would not necessitate dredging and filling operations in the Bay, this technology would be in compliance with the McAteer-Pteris Act.

Conclusion for Soil and Water Resources

The proposed once-through cooling system would require dredging and filling within the Bay in order to install an intake structure and two outfall structures. The dry and hybrid cooling technologies eliminate the need for intake/outfall structures and are limited to upland locations.

The dry cooling alternatives would be limited to on-site earthmoving activities and the structure would encompass approximately 1.5 acres. The hybrid cooling alternative would require both on-site and off-site earthmoving activities, as well as boring under Islais Creek, resulting in earthmoving disturbance on approximately 3 acres. Because earthmoving activities related to either dry cooling site would be limited to the Unit 7 area, dry cooling would have fewer impacts than the hybrid cooling option, which requires construction of an off-site pipeline. Thus, the dry cooling option would be the preferred alternative from an erosion and sedimentation perspective related to soil and water resources.

Both the dry cooling and once-through cooling options would have less than significant impacts related to erosion and sedimentation via the aforementioned supporting mitigation measures. However, as described in the **Soil and Water Resources** section of the FSA, the once-through cooling process would not be in compliance with the McAteer-Petris Act. In contrast, the dry cooling option is not subject to the McAteer-Petris Act because construction and operation would be restricted to an upland location.

From a Soil and Water LORS standpoint, the dry cooling option would be preferred. There is little difference between the dry cooling alternative locations.

5 ENGINEERING ANALYSIS OF COOLING OPTIONS

This Chapter presents analysis of cooling options in three engineering areas: Facility Design, Power Plant Reliability and Efficiency, and Geology and Paleontology.

5.1 FACILITY DESIGN

Facility Design encompasses the civil, structural, mechanical, and electrical engineering design of the project. The purpose of the Facility Design analysis is to, among other things, provide reasonable assurance that the project can be designed and constructed in accordance with all applicable LORS and in a manner that assures public health and safety. Conditions of Certification have been established that will ensure that the proposed power plant is designed and constructed in compliance with applicable LORS.

Introduction

Three alternative cooling options (conceptual design level of detail) have been identified for the Unit 7 power plant: two dry cooling system alternatives, and one hybrid (wet/dry) cooling system alternatives. Each of the cooling system alternatives would require the construction of some fixed facilities (e.g., foundations, structures, mechanical systems, electrical systems, control systems, etc.). The proposed Conditions of Certification for this project cover the design and construction of these types of fixed facilities.

Facility Design Impacts of Dry Cooling

The dry cooling system alternatives would require the construction of some fixed facilities (e.g., foundations, structures, mechanical systems, electrical systems, control systems, etc.). The proposed Conditions of Certification cover the design and construction of these types of fixed facilities. If one of the dry cooling system alternatives is selected, Table 1, included in the Facility Design Final Staff Assessment, will need to be revised accordingly.

Facility Design Impacts of Hybrid Cooling

The hybrid cooling system alternative would also require the construction of some fixed facilities (e.g., foundations, structures, mechanical systems, electrical systems, control systems, etc.). The proposed Conditions of Certification cover the design and construction of these types of fixed facilities. If the hybrid cooling system alternative is selected, **FACILITY DESIGN Table 1** in the **Facility Design** FSA Section will need to be revised accordingly.

Conclusion for Facility Design

The proposed Conditions of Certification adequately address the engineering concerns associated with all identified cooling system options. If an alternative cooling system is selected, Table 1 in the **Facility Design** FSA Section will need to be revised. This table lists the major structures and equipment associated with the facility. The proposed Conditions of Certification require the Applicant to submit pertinent design documents for these major structures and equipment to the Chief Building Official (CBO). The CBO would then verify that the designs and construction are in accordance with applicable LORS.

5.2 POWER PLANT RELIABILITY AND EFFICIENCY

Reliability

In this analysis, the reliability issues of the alternate cooling systems are assessed to determine if they would significantly impact the proposed power plant reliability. As a basis, typical industry norms for reliability of power generation are considered. Using this level of reliability as a benchmark measures the project likelihood of not degrading the overall reliability of the electric system it serves compared to the proposed once-through cooling system.

The scope of this power plant reliability analysis covers:

- Equipment and plant availability; and
- Water availability.

Equipment required for both the dry and the wet/dry cooling alternatives is commonly available within the power generating industry in sizes and configurations similar to the Unit 7 plant (See Sections 2.1 and 2.2 of this Appendix). Plant availability is reduced with the dry cooling system and also, but to a lesser extent with the wet/dry cooling system when compared to the once-through system. This is due to the fact that on high temperature days when the plant output is most likely to be needed to supply peak electrical loads, the plant capabilities are reduced. This is because during these conditions the condenser backpressure will increase causing the steam turbine output to be reduced. The extent of this reduction will vary depending upon specific weather conditions.

Water availability is not an issue for the dry air-cooled condenser cooling system since the turbine exhaust steam is sent directly to the air-cooled condenser and requires no intermediate water for cooling. However, for the wet/dry system water is required for the cooling tower makeup due to losses from evaporation, drift, and blowdown. This water would be provided from the Southeast Water Pollution Control Plant secondary effluent. After treatment to a tertiary level the water would be used as makeup to the wet/dry system. As stated above this, supply is subject to as much as 12 outages per year with durations up to 22 hours in length. To overcome this exposure, storage facilities would be required for 3.5-4 million gallons of treated water.

With proper design considerations, plant reliability would not be impacted to a degree that would make the construction and operation of Unit 7 unacceptable.

Efficiency

The efficiency consideration in this assessment of the alternate cooling systems is reviewed to determine if any additional consumption of energy creates a significant adverse impact. In this analysis staff addresses the issue of inefficient and unnecessary consumption of energy.

The primary points assessed are to:

- Determine whether the facility would likely present any adverse impacts upon energy resources;
- Determine whether these adverse impacts are significant

Both the dry and wet/dry alternative cooling systems would result in the less efficient use of fuel when compared to the proposed once-through cooling system. This is due to the reduced output described in this assessment when using either dry or wet/dry alternatives. Considering the dry air-cooled condenser alternative, the drop in efficiency would be expected to be approximately 2.5% on an annual basis. For the wet/dry alternative this drop would be expected to be approximately 1% on an annual basis.

These drops in efficiencies would not be deemed to be great enough to cause any significant adverse impacts to the availability of fuel, nor would they be considered to be wasteful, inefficient or cause unnecessary fuel or energy consumption.

5.3 GEOLOGY AND PALEONTOLOGY

Introduction

Two alternative locations have been proposed for the dry cooling structure: Dry Cooling Alternative One is located on the eastern half of the power plant site and overlies tidelands deposits, and Dry Cooling Alternative Two is located in the northwest corner of the site and overlies serpentinite bedrock. The proposed once-through cooling water intake structure would overlie fill and bay mud deposits along the margin of San Francisco Bay.

The Hybrid Cooling Alternative would parallel the cooling water discharge pipeline along the southern margin of the site and span the bedrock that originally formed Potrero Point and the tidelands reclaimed from the bay. The western half of the Hybrid Cooling Alternative would be founded on bedrock, while the eastern half would overlie fill and bay mud deposits.

The serpentinite bedrock varies in depth underneath the existing Potrero Power Plant site from a depth of generally less than five feet below grade in the northwest corner of the site, to up to eighty-five feet below grade immediately adjacent to the bay. The entire site is mantled by artificial fill. Between 5 and 20 feet of fill overlie the bedrock and tidal flat deposits of bay mud and/or alluvium.

Geology and Paleontology Impacts of Dry and Hybrid Cooling

Geologic Hazards

Faulting and Seismicity. No active or potentially active faults are known to cross the Potrero Power Plant site. Therefore, the potential for fault rupture beneath the footprint of any of the cooling alternatives is considered to be very low.

The ground shaking impacts for the Dry/Wet and Dry Cooling Alternatives are similar to the impacts for the Potrero Power Plant Unit 7 Project. Using the Abrahamson-Silva 1997 attenuation relationship, a moment magnitude 7.9 earthquake on the San Andreas fault would produce an estimated peak bedrock acceleration for the power plant site of 0.65g. Dry Cooling Alternative 2 will be located on bedrock and will be subject to the estimated peak bedrock acceleration. The Hybrid Cooling Alternative and Dry Cooling Alternative 1 would be located over younger bay mud deposits, which may amplify the peak ground accelerations.

The calculated peak ground acceleration is generally consistent with the California Division of Mines and Geology (CDMG) Map Sheet 48, which predicts a peak ground acceleration with a 10% chance of exceedance in 50 years of between 0.5 g and 0.6 g for the project area.

Liquefaction, Hydrocompaction, and Expansive Soils. The depth to groundwater at the proposed site generally varies from approximately 2 feet below existing grade to 14.5 feet below existing grade. The combination of saturated soils of varying density and a potential for a moderately high peak horizontal ground acceleration points to a moderate potential for liquefaction at the site. Due to the heterogeneous character of the fill, potentially liquefiable soils are expected to occur as zones or pockets, rather than as horizontally or vertically continuous layers. The potential for liquefaction induced lateral spreading within the fill is considered low because of the low surface gradients at the project site and the heterogeneous nature of the fill. Localized subsidence due to seismically induced densification of loose granular zones of fill is considered the most likely expression of liquefaction at the project site. Both the Dry/Wet Cooling Alternative and Dry Cooling Alternative One are located over potentially liquefiable soils. Dry Cooling Alternative Two is located over bedrock and would not be subject to liquefaction. Liquefaction is to be accounted for during the final design of the project's foundation.

The potential for damage to the project facilities from expansive soils is expected to be low.

Landslides. Landsliding potential at the power plant site is considered to be low, since the project is located on a fill pad that has a slope of between 1% and 2%.

Geological and Paleontological Resources

No geological resources have been identified at the power plant location or surrounding area.

The proposed expansion site footprint is highly disturbed and the bay deposits beneath the site are geologically very young. Therefore, excavations, drilling, clearing and brushing operations, and grading of the fill, alluvium, and bay deposits at the power plant site associated with construction of the cooling structure alternatives are considered to present a low potential impact to paleontological resources.

Conclusion for Geology and Paleontology

Staff proposes to ensure compliance with applicable LORS for geological hazards, geological and paleontological resources for the selected cooling alternative with the adoption of the proposed Conditions of Certification in the **Geology and Paleontology** FSA section.

The only significant geologic hazards associated with the cooling alternatives are strong ground shaking and liquefaction potential. Condition of Certification **GEO-2** requires preparation of a Engineering Geology Report that addresses these issues and provides design recommendations to mitigate any potential impacts. The project should have no adverse impact with respect to geological and paleontological resources, if project design and construction complies with Condition of Certification **GEO-2** and the applicable LORS.

In addition, the adoption and implementation of the proposed monitoring program outlined in the Conditions of Certification for paleontology should mitigate any potential impacts to paleontological resources encountered construction of this project.

6 CONCLUSION: COMPARISON OF COOLING OPTIONS

Chapters 4 and 5 of this Appendix describe the potential impacts of dry cooling (in two possible locations) and hybrid cooling facilities to serve the Potrero Unit 7 Project. These cooling facilities would replace the proposed use of once-through cooling, and the existing intake and outfall serving Unit 3 would remain unchanged. This study was undertaken because of potential significant impacts of once-through cooling to aquatic biological resources, and to satisfy the alternatives analysis requirement of the McAteer-Petris Act under which BCDC operates.

The environmental and engineering disciplines can be divided into two groups: those with the potential for significant impacts, and those in which impacts are easily mitigable or less than significant. Disciplines in which impacts would be less than significant for all three types of cooling (some with implementation of standard mitigation or conditions of certification) are the following:

- Cultural resources
- Hazardous materials
- Worker safety
- Public health
- Traffic and transportation
- Water and soil
- Geology and paleontology
- Terrestrial biology
- Waste
- Power plant reliability

The disciplines where potential impacts from dry and hybrid cooling technologies are of most concern are air quality, noise, visual resources, and land use. Plant operators also indicate concerns about power plant efficiency. The conclusions of these analyses are described below.

- **Air Quality**: Emissions for dry and hybrid cooling would be greater than those for once-through cooling, but impacts are found to be less than significant because offsets are required. Particulate emissions would be slightly greater with both dry and hybrid cooling because in dry cooling, fans would re-suspend particulate matter in the area, and hybrid cooling creates minor particulate emissions associated with cooling tower drift. This conclusion in air quality results in a finding that public health impacts of dry and hybrid cooling would also be less than significant.
- **Noise:** Noise from dry and hybrid cooling would create significant impacts if the proposed designs (as defined in Chapter 3) were used. However, design options are presented in which fan configuration is modified and noise levels are reduced to less than significant levels. Additional noise mitigation is described, but not recommended since fan design alone would reduce noise to acceptable levels.
- **Visual Resources:** The visual impacts of each cooling option are evaluated from key viewpoints surrounding the Potrero site. Visual impacts of the hybrid cooling tower are found to be less than significant, but the visual impacts of both dry cooling options are found to be significant and unmitigable from several key viewpoints. The finding that dry cooling would have a significant visual impact creates secondary significant impact determinations a land use compatibility impact and a concern in

socioeconomics about community perception and compatibility of the site with the neighborhood.

- **Land Use:** The dry cooling alternative (at either site) would create land use incompatibility impacts stemming from significant impacts to visual resources. From a land use perspective, the proposed project and the hybrid cooling alternative are not substantially different from each other.
- **Power Plant Efficiency:** As described in Chapters 2 and 3, dry and hybrid cooling technologies are less efficient than once-through cooling in cooling steam, so power generation is slightly reduced using these technologies. Also, additional electricity is required to operate the cooling fans, so net power generation is reduced for that reason as well. The reductions in efficiency are found to be small (2.5% for dry cooling and 1% for hybrid cooling), and they are determined not to cause significant adverse impacts on the availability of fuel or to cause wasteful or inefficient energy consumption.

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LIST OF CONTRIBUTORS

ENVIRONMENTAL ANALYSIS OF COOLING OPTIONS

Air Quality: Tuan Ngo, P.E.

Biological Resources – Aquatic: Noel Davis, Ph.D. and Rick York.

Biological Resources – Terrestrial: Shari Koslowsky and Rick York.

Cultural Resources: Roger Mason, Ph.D. and Gary Reinoehl.

Hazardous Materials Management; Worker Safety and Fire Protection: Alvin J. Greenberg, Ph.D. and Rick Tyler.

Land Use: Jon Davidson.

Noise: Jim Buntin.

Public Health: Obed Odoemelam, Ph.D.

Socioeconomic Resources: Michael Fajans and Amanda Stennick.

Traffic and Transportation: James Fore.

Visual Resources: Michael Clayton

Waste Management: Michael Ringer.

Soil and Water Resources: Joe Crea.

ENGINEERING ANALYSIS OF COOLING OPTIONS

Facility Design: Brian Payne.

Power Plant Reliability; Power Plant Efficiency: James C. Henneforth.

Geology and Paleontology: Neal Mace.